

GE Healthcare

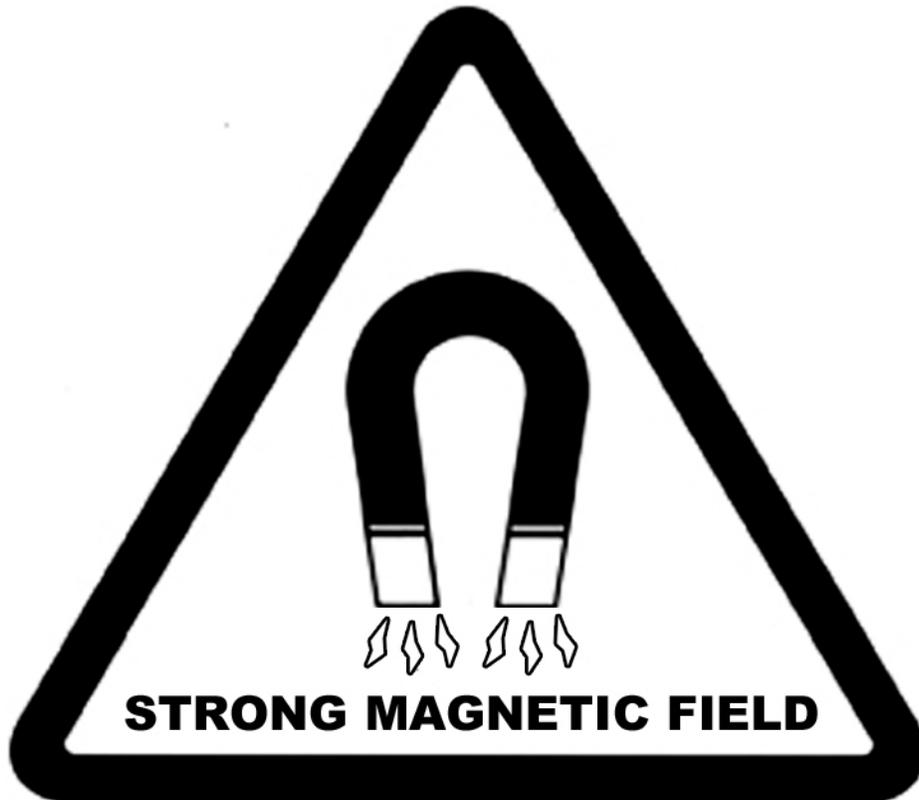
Signa HDe 1.5T Pre-Installation



OPERATING DOCUMENTATION

5143464
Revision 7

WARNING



**NO PACEMAKERS
NO METALLIC IMPLANTS**

Persons with pacemakers, neurostimulators or metallic implants must not enter the magnet area. Serious injury may result.



NO LOOSE METAL OBJECTS

Iron and steel materials must not be taken into the magnet area. Serious injury or property damage may result.

Important Information

LANGUAGE

ПРЕДУПРЕЖДЕНИЕ Това упътване за работа е налично само на английски език с
(BG) изключението на случаите, когато се изисква изрично по друг начин от местното законодателство, или от споразумение на местно ниво.

- Ако доставчикът на услугата на клиента изиска друг език, задължение на клиента е да осигури превод.
- Не използвайте оборудването, преди да сте се консултирали и разбрали упътването за работа.
- Неспазването на това предупреждение може да доведе до нараняване на доставчика на услугата, оператора или пациента в резултат на токов удар, механична или друга опасност.

警告 本维修手册仅提供英文版本，除非当地法律或本地供应协议另有明确要求。
(ZH-CN)

- 如果客户的维修服务人员需要非英文版本，则客户需自行提供翻译服务。
- 未详细阅读和完全理解本维修手册之前，不得进行维修。
- 忽略本警告可能对维修服务人员、操作人员或患者造成触电、机械伤害或其他形式的伤害。

VÝSTRAHA Tento provozní návod existuje pouze v anglickém jazyce, pokud není jinak
(CS) výslovně vyžadováno místními zákony nebo odsouhlaseno na místní úrovni.

- V případě, že externí služba zákazníkům potřebuje návod v jiném jazyce, je zajištění překladu do odpovídajícího jazyka úkolem zákazníka.
- Nesnažte se o údržbu tohoto zařízení, aniž byste si přečetli tento provozní návod a pochopili jeho obsah.
- V případě nedodržování této výstrahy může dojít k poranění pracovníka prodejního servisu, obslužného personálu nebo pacientů vlivem elektrického proudu, respektive vlivem mechanických či jiných rizik.

ADVARSEL

(DA)

Denne servicemanual findes kun på engelsk, medmindre andet kræves i henhold til lokal lovgivning eller lokal aftale.

- Hvis en kundes tekniker har brug for et andet sprog end engelsk, er det kundens ansvar at sørge for oversættelse.
- Forsøg ikke at servicere udstyret uden at læse og forstå denne servicemanual.
- Manglende overholdelse af denne advarsel kan medføre skade på grund af elektrisk stød, mekanisk eller anden fare for teknikeren, operatøren eller patienten.

WAARSCHUWING

(NL)

Deze onderhoudshandleiding is enkel in het Engels verkrijgbaar, tenzij expliciet vereist door plaatselijke regelgeving of overeengekomen op lokaal niveau.

- Als het onderhoudspersoneel een andere taal vereist, dan is de klant verantwoordelijk voor de vertaling ervan.
- Probeer de apparatuur niet te onderhouden alvorens deze onderhoudshandleiding werd geraadpleegd en begrepen is.
- Indien deze waarschuwing niet wordt opgevolgd, zou het onderhoudspersoneel, de operator of een patiënt gewond kunnen raken als gevolg van een elektrische schok, mechanische of andere gevaren.

WARNING

(EN)

This service manual is available in english only except as otherwise expressly required by local law or agreed to at a local level.

- If a customer's service provider requires a language other than english, it is the customer's responsibility to provide translation services.
- Do not attempt to service the equipment unless this service manual has been consulted and is understood.
- Failure to heed this warning may result in injury to the service provider, operator or patient from electric shock, mechanical or other hazards.

HOIATUS

(ET)

See teenindusjuhend on saadaval ainult inglise keeles, kui kohalikud seadused ei ütle teisiti või kui kohalikes õigusaktides ei ole otseselt teisiti ette nähtud.

- Kui klienditeeninduse osutaja nõuab juhendit inglise keelest erinevas keeles, vastutab klient tõlketeenuse osutamise eest.
- Ärge üritage seadmeid teenindada enne eelnevalt käesoleva teenindusjuhendiga tutvumist ja sellest aru saamist.
- Käesoleva hoiatuse eiramine võib põhjustada teenuseosutaja, operaatori või patsiendi vigastamist elektrilöögi, mehaanilise või muu ohu tagajärjel.

VAROITUS

(FI)

Tämä huolto-ohje on saatavilla vain englanniksi, ellei paikallinen laki nimenomaan toisin vaadi tai jos toisin on sovittu paikallisella tasolla.

- Jos asiakkaan huoltohenkilöstö vaatii muuta kuin englanninkielistä materiaalia, tarvittavan käännöksen hankkiminen on asiakkaan vastuulla.
- Älä yritä korjata laitteistoa ennen kuin olet varmasti lukenut ja ymmärtänyt tämän huolto-ohjeen.
- Mikäli tätä varoitusta ei noudateta, seurauksena voi olla huoltohenkilöstön, laitteiston käyttäjän tai potilaan vahingoittuminen sähköiskun, mekaanisen vian tai muun vaaratilanteen vuoksi.

ATTENTION

(FR)

Sauf exigence contraire des lois locales ou accord contraire au niveau local, ce manuel d'installation et de maintenance n'est disponible qu'en anglais.

- Si le technicien d'un client a besoin de ce manuel dans une langue autre que l'anglais, il incombe au client de le faire traduire.
- Ne pas tenter d'intervenir sur les équipements tant que ce manuel d'installation et de maintenance n'a pas été consulté et compris.
- Le non-respect de cet avertissement peut entraîner chez le technicien, l'opérateur ou le patient des blessures dues à des dangers électriques, mécaniques ou autres.

WARNUNG

(DE)

Diese Serviceanleitung existiert nur in englischer Sprache, sofern nichts anderes gesetzlich vorgeschrieben oder auf lokaler Ebene vereinbart wurde.

- Falls ein fremder Kundendienst eine andere Sprache benötigt, ist es Aufgabe des Kunden für eine Entsprechende Übersetzung zu sorgen.
- Versuchen Sie nicht diese Anlage zu warten, ohne diese Serviceanleitung gelesen und verstanden zu haben.
- Wird diese Warnung nicht beachtet, so kann es zu Verletzungen des Kundendiensttechnikers, des Bedieners oder des Patienten durch Stromschläge, mechanische oder sonstige Gefahren kommen.

ΠΡΟΕΙΔΟΠΟΙΗΣΗ

(EL)

Το παρόν εγχειρίδιο σέρβις διατίθεται μόνο στα αγγλικά, εκτός αν η τοπική νομοθεσία απαιτεί κάτι άλλο ή υπάρχει διαφορετική συμφωνία σε τοπικό επίπεδο.

- Εάν ο τεχνικός σέρβις ενός πελάτη απαιτεί το παρόν εγχειρίδιο σε γλώσσα εκτός των αγγλικών, αποτελεί ευθύνη του πελάτη να παρέχει τις υπηρεσίες μετάφρασης.
- Μην επιχειρήσετε την εκτέλεση εργασιών σέρβις στον εξοπλισμό αν δεν έχετε συμβουλευτεί και κατανοήσει το παρόν εγχειρίδιο σέρβις.
- Αν δεν προσέξετε την προειδοποίηση αυτή, ενδέχεται να προκληθεί τραυματισμός στον τεχνικό σέρβις, στο χειριστή ή στον ασθενή από ηλεκτροπληξία, μηχανικούς ή άλλους κινδύνους.

FIGYELMEZTETÉS

(HU)

Ezen karbantartási kézikönyv kizárólag angol nyelven érhető el, kivéve ha a helyi rendelkezések ezt kifejezetten elő nem írják, illetve ha helyi szinten erről külön megállapodás nem születik.

- Ha a vevő szolgáltatója angoltól eltérő nyelvre tart igényt, akkor a vevő felelőssége a fordítás elkészítése.
- Ne próbálja elkezdni használni a berendezést, amíg a karbantartási kézikönyvben leírtakat nem értelmezték.
- Ezen figyelmeztetés figyelmen kívül hagyása a szolgáltató, működtető vagy a beteg áramütés, mechanikai vagy egyéb veszélyhelyzet miatti sérülését eredményezheti.

AÐVÖRUN

(IS)

Þessi þjónustuhandbók er eingöngu fánleg á ensku, nema annað sé sérstaklega krafist, löglega eða samþykkt á landsgrundvelli.

- Ef að þjónustuveitandi viðskiptamanns þarfnast annas tungumáls en ensku, er það skylda viðskiptamanns að skaffa tungumálaþjónustu.
- Reynið ekki að afgreiða tækið nema að þessi þjónustuhandbók hefur verið skoðuð og skilin.
- Brot á sinna þessari aðvörðun getur leitt til meiðsla á þjónustuveitanda, stjórnanda eða sjúklings frá raflosti, vélrænu eða öðrum áhættum.

AVVERTENZA

(IT)

Il presente manuale di manutenzione è disponibile soltanto in inglese, eccetto quando espressamente richiesto dalle normative locali o convenuto a livello locale.

- Se un addetto alla manutenzione richiede il manuale in una lingua diversa, il cliente è tenuto a provvedere direttamente alla traduzione.
- Procedere alla manutenzione dell'apparecchiatura solo dopo aver consultato il presente manuale ed averne compreso il contenuto.
- Il mancato rispetto della presente avvertenza potrebbe causare lesioni all'addetto alla manutenzione, all'operatore o ai pazienti provocate da scosse elettriche, urti meccanici o altri rischi.

警告

(JA)

このサービスマニュアルには英語版しかありません。ただし使用国の法令に別異の定めがある、あるいは現地で別段の合意がある場合を除きます。

- サービスを担当される業者が英語以外の言語を要求される場合、翻訳作業はその業者の責任で行うものとさせていただきます。
- このサービスマニュアルを熟読し理解せずに、装置のサービスを行わないでください。
- この警告に従わない場合、サービスを担当される方、操作員あるいは患者さんが、感電や機械的又はその他の危険により負傷する可能性があります。

경고

(KO)

현지 법률에 따라 명시적으로 요구하거나 현지 수준에서 합의한 경우를 제외하고 본 서비스 매뉴얼은 영어로만 이용하실 수 있습니다.

- 고객의 서비스 제공자가 영어 이외의 언어를 요구할 경우, 번역 서비스를 제공하는 것은 고객의 책임입니다.
- 본 서비스 매뉴얼을 참조하여 숙지하지 않은 이상 해당 장비를 수리하려고 시도하지 마십시오.
- 본 경고 사항에 유의하지 않으면 전기 쇼크, 기계적 위험, 또는 기타 위험으로 인해 서비스 제공자, 사용자 또는 환자에게 부상을 입힐 수 있습니다.

BRĪDINĀJUMS

(LV)

Šī apkalpes rokasgrāmata ir pieejama tikai angļu valodā, izņemot gadījumus, kad vietējie likumi nepārprotami nosaka citādi vai panākta vienošanās vietējā līmenī.

- Ja klienta apkalpes sniedzējam nepieciešama informācija citā valodā, nevis angļu, klienta pienākums ir nodrošināt tulkošanu.
- Neveiciet aprīkojuma apkalpi bez apkalpes rokasgrāmatas izlasīšanas un saprašanas.
- Šī brīdinājuma neievērošana var radīt elektriskās strāvas trieciena, mehānisku vai citu risku izraisītu traumu apkalpes sniedzējam, operatoram vai pacientam.

ĮSPĖJIMAS

(LT)

Šis eksploataavimo vadovas yra tik anglų kalba, išskyrus tuos atvejus, kai vietiniai įstatymai tiesiogiai numato kitokius reikalavimus arba vietinių lygiu sutarta kitaip.

- Jei kliento paslaugų tiekėjas reikalauja vadovo kita kalba – ne anglų, suteikti vertimo paslaugas privalo klientas.
- Nemėginkite atlikti įrangos techninės priežiūros, jei neperskaitėte ar nesupratote šio eksploataavimo vadovo.
- Jei nepaisysite šio įspėjimo, galimi paslaugų tiekėjo, operatoriaus ar paciento sužalojimai dėl elektros šoko, mechaninių ar kitų pavojų.

ADVARSEL

(NO)

Denne servicehåndboken finnes bare på engelsk, bortsett fra dersom det motsatte uttrykkelig er fastsatt av lokal lovgivning eller det er inngått annen avtale lokalt.

- Hvis kundens serviceleverandør trenger et annet språk, er det kundens ansvar å sørge for oversettelse.
- Ikke forsøk å reparere utstyret uten at denne servicehåndboken er lest og forstått.
- Manglende hensyn til denne advarselen kan føre til at serviceleverandøren, operatøren eller pasienten skades på grunn av elektrisk støt, mekaniske eller andre farer.

OSTRZEŻENIE

(PL)

Niniejszy podręcznik serwisowy dostępny jest jedynie w języku angielskim, chyba że lokalne przepisy lub umowy wyraźnie stanowią inaczej.

- Jeśli dostawca usług klienta wymaga języka innego niż angielski, zapewnienie usługi tłumaczenia jest obowiązkiem klienta.
- Nie próbować serwisować wyposażenia bez zapoznania się z niniejszym podręcznikiem serwisowym i zrozumienia go.
- Niezastosowanie się do tego ostrzeżenia może spowodować urazy dostawcy usług, operatora lub pacjenta w wyniku porażenia prądem elektrycznym, zagrożenia mechanicznego bądź innego.

ATENȚIE

(RO)

Acest manual de service este disponibil numai în limba engleză, cu excepția cazului în care este o cerință obligatorie stipulată de legislația națională sau convenită la nivel local.

- Dacă un furnizor de servicii pentru clienți necesită o altă limbă decât cea engleză, este de datoria clientului să furnizeze o traducere.
- Nu încercați să reparați echipamentul decât ulterior consultării și înțelegerii acestui manual de service.
- Ignorarea acestui avertisment ar putea duce la rănirea depanatorului, operatorului sau pacientului în urma pericolelor de electrocutare, mecanice sau de altă natură.

ОСТОРОЖНО!

(RU)

Данное руководство по техническому обслуживанию предлагается только на английском языке, за исключением тех случаев, когда наличие руководства на национальном языке является требованием местного законодательства или когда выпуск такого руководства согласован с местным представительством.

- Если сервисному персоналу клиента необходимо руководство не на английском, а на каком-то другом языке, клиенту следует самостоятельно обеспечить перевод.
- Перед техническим обслуживанием оборудования обязательно обратитесь к данному руководству и поймите изложенные в нем сведения.
- Несоблюдение требований данного предупреждения может привести к тому, что специалист по техобслуживанию, оператор или пациент получит удар электрическим током, механическую травму или другое повреждение.

UPOZORNENIE

(SK)

Tento návod na obsluhu je k dispozícii len v angličtine, okrem prípadov, kedy tak výslovne vyžadujú miestne zákony alebo je dohodnuté na miestnej úrovni.

- Ak zákaznikov poskytovateľ služieb vyžaduje iný jazyk ako angličtinu, poskytnutie prekladateľských služieb je zodpovednosťou zákazníka.
- Nepokúšajte sa o obsluhu zariadenia, kým si neprečítate návod na obsluhu a neporozumiete mu.
- Zanedbanie tohto upozornenia môže spôsobiť zranenie poskytovateľa služieb, obsluhujúcej osoby alebo pacienta elektrickým prúdom, mechanické alebo iné ohrozenie.

ATENCION

(ES)

Este manual de servicio sólo existe en inglés, salvo que la legislación local exija de forma expresa lo contrario, o así se haya acordado a nivel local.

- Si el encargado de mantenimiento de un cliente necesita un idioma que no sea el inglés, el cliente deberá encargarse de la traducción del manual.
- No se deberá dar servicio técnico al equipo, sin haber consultado y comprendido este manual de servicio.
- La no observancia del presente aviso puede dar lugar a que el proveedor de servicios, el operador o el paciente sufran lesiones provocadas por causas eléctricas, mecánicas o de otra naturaleza.

VARNING

(SV)

Den här servicehandboken finns bara tillgänglig på engelska om inte annat uttryckligen krävs av lokal lag eller har överenskommit på lokal nivå.

- Om en kunds servicetekniker har behov av ett annat språk än engelska, ansvarar kunden för att tillhandahålla översättningstjänster.
- Försök inte utföra service på utrustningen om du inte har läst och förstår den här servicehandboken.
- Om du inte tar hänsyn till den här varningen kan det resultera i skador på serviceteknikern, operatören eller patienten till följd av elektriska stötar, mekaniska faror eller andra faror.

DİKKAT

(TR)

Aksi, yerel bir yasa tarafından açıkça gerekli görülmediği veya yerel bir seviyede kabul edilmediği takdirde, bu servis kılavuzunun sadece İngilizcesi mevcuttur.

- Eğer müşteri teknisyeni bu kılavuzu İngilizce dışında bir başka lisandan talep ederse, bunu tercüme ettirmek müşteriye düşer.
- Servis kılavuzunu okuyup anlamadan ekipmanlara müdahale etmeyiniz.
- Bu uyarıya uyulmaması, elektrik, mekanik veya diğer tehlikelerden dolayı teknisyen, operatör veya hastanın yaralanmasına yol açabilir.

AVISO

(PT-BR)

Este manual de assistência técnica encontra-se disponível unicamente em inglês, salvo disposições em contrário previstas pela legislação local ou acordadas no âmbito local.

- Se outro serviço de assistência técnica solicitar a tradução deste manual, caberá ao cliente fornecer os serviços de tradução.
- Não tente reparar o equipamento sem ter consultado e compreendido este manual de assistência técnica.
- A não observância deste aviso pode ocasionar ferimentos no técnico, operador ou paciente decorrentes de choques elétricos, mecânicos ou outros.

ATENÇÃO
(PT-PT)

Este manual de assistência técnica só se encontra disponível em inglês, salvo requisição expressa pela legislação local ou acordo efectuado a nível local.

- Se qualquer outro serviço de assistência técnica solicitar este manual noutro idioma, é da responsabilidade do cliente fornecer os serviços de tradução.
- Não tente reparar o equipamento sem ter consultado e compreendido este manual de assistência técnica.
- O não cumprimento deste aviso pode colocar em perigo a segurança do técnico, do operador ou do paciente devido a choques eléctricos, mecânicos ou outros.

UPOZORENJE
(SR)

Ovo servisno uputstvo je dostupno samo na engleskom jeziku, sem ako lokalni zakon to izričito zahteva ili je dogovoreno na lokalnom nivou.

- Ako klijentov serviser zahteva neki drugi jezik, klijent je dužan da obezbedi prevodilačke usluge.
- Ne pokušavajte da opravite uređaj ako niste pročitali i razumeli ovo servisno uputstvo.
- Zanemarivanje ovog upozorenja može dovesti do povređivanja serviser, rukovaoca ili pacijenta usled strujnog udara ili mehaničkih i drugih opasnosti.

UPOZORENJE
(HR)

Ovaj servisni priručnik dostupan je na engleskom jeziku.

- Ako davatelj usluge klijenta treba neki drugi jezik, klijent je dužan osigurati prijevod.
- Ne pokušavajte servisirati opremu ako niste u potpunosti pročitali i razumjeli ovaj servisni priručnik.
- Zanemarite li ovo upozorenje, može doći do ozljede davatelja usluge, operatera ili pacijenta uslijed strujnog udara, mehaničkih ili drugih rizika.

警告
(ZH-TW)

本維修手冊僅有英文版。

- 若客戶的維修廠商需要英文版以外的語言，應由客戶自行提供翻譯服務。
- 請勿試圖維修本設備，除非您已查閱並瞭解本維修手冊。
- 若未留意本警告，可能導致維修廠商、操作員或病患因觸電、機械或其他危險而受傷。

警告
(ZH-HK)

本服務手冊僅提供英文版本。

- 倘若客戶的服務供應商需要英文以外之服務手冊，客戶有責任提供翻譯服務。
- 除非已參閱本服務手冊及明白其內容，否則切勿嘗試維修設備。
- 不遵從本警告或會令服務供應商、網絡供應商或病人受到觸電、機械性或其他危險。

OPOZORILO
(SL)

Ta servisni priročnik je na voljo samo v angleškem jeziku.

- Če ponudnik storitve stranke potrebuje priročnik v drugem jeziku, mora stranka zagotoviti prevod.
- Ne poskušajte servisirati opreme, če tega priročnika niste v celoti prebrali in razumeli.
- Če tega opozorila ne upoštevate, se lahko zaradi električnega udara, mehanskih ali drugih nevarnosti poškoduje ponudnik storitev, operater ali bolnik.

This page left intentionally blank.

Revision History

Revision	Date	Description
1	Nov 22, 2005	Initial Release
2	Jul 20, 2006	Updated according to feedback of M3 systems.
3	Dec 6, 2006	<p>Room Layout Chapter:Chapter 3, Room Sizes added exit route wording to heading of Room Dimensions table. Chapter 3, MR System Interconnects Routing MR System Interconnects Routing Requirements/Recommendations table reformatted to number requirements and updated requirements to be consistent with revised Magnet Room floor requirement of metal access floor tiles not allowed anywhere: Row titled Entire MR System;: recommendation for use of access flooring deleted.; Row titled Magnet Room: deleted access floor note and added metal floor access tiles not allowed with reference to Magnet Room Floors requirement in RF Shielded Room chapter. Chapter 3, Customer Site Storage Requirements added section with reference to Direction 5182674 GE Healthcare Signa MRI Scanners Customer Site Storage Requirements for for size and weight of surface coils and phantoms that require customer provided storage locations.Chapter 3, Outdoor Unit for Type A Configuration added '4 . Minimum Radius of Flexible Gas Line' and '5. Recommended Conduit for Outdoor Compressor Cable'.Chapter 3, Floor Loading and Weights table titled Notes For System Components Floor Loading Table, Note 5 2nd sentence changed to Contact your local GE Healthcare Project Manager, Installations for seismic information if the MR system equipment is required by code to be anchored." Deleted dewars information in Floor Loading table since Chapter 3, Minimum Delivery Route Sizes and Capacity lists cryogen delivery route requirements. Chapter 3, Magnet and Enclosure Magnet Mounting Recess Area requirements/information updated in Load Pattern tables. Magnet Mounting recessed area depth dimension tolerances changed to 1.5 in. +0 / -0.125 in. (38.1mm +0 / -3.175 mm) to be consistent with Magnet Room Floors specification changes. Chapter 3, Mesh Shield and System Cabinet Cover Corrected size of mesh shield.</p> <p>Site Environment Chapter:Chapter 5, Room Ventilation Ventilation Requirements/ Recommendations table reformatted for 1 column with numbered list of requirements. Incorporated Magnet Room ventilation switch placement requirement (removed from RF Shielded Room Chapter).</p> <p>Power Requirements Chapter:Chapter 6, Critical Power Requirements Critical Power Requirements table, Configuration row: added missing bullet defining Recommended input configuration 3 phase solidly Grounded WYE.</p> <p>Interconnect Data Chapter: Corrected Group length of Group 87 to 37 (11.3) in Chapter 7, Cable Groups Length Provided.</p>
3 (Continued)		<p>RF Shielded Room Chapter:Chapter 8, RF Shielded Room Requirements RF Shielded Room Requirements table, row titled Construction, Note text deleted 'e.g. aluminum'. Chapter 8, Magnet Room Floors major changes incorporated:</p> <ul style="list-style-type: none"> • Added Notice for Magnet Mounting recessed area required for all installations. • Rewrote entire section to simplify requirements, used feedback from Project Managers - Installations and Zone Support Engineers. • Same levelness requirements for all Magnet Room floor areas. • Magnet Mounting Recess Area depth and levelness tolerances changed to +0 / -0.125 in. (+0 / 3.175 mm). Added RF Shield material seams MUST NOT be located in projected areas of the VibroAcoustic mats. • Metal access floor tiles are NOT allowed in Magnet Room. • Illustration revised to show recessed area with Vibroacoustic mats projected locations. <p>Shipping and Delivery Data Chapter:Chapter 9, Shipment Patient Table shipping dimensions and weights revised for new packaging.</p> <p>Tools and Test Equipment Chapter:Chapter 11, Installation Equipment Updated several part numbers: -Field Plotting Kit 46-251865G4 -Magnet Ramping Equipment Kit part number updated to 46-260703G5 -Non-Magnetic Tool Kit replaced by new Titanium Non-Magnetic Tool Kits.</p>
4	Mar 26, 2007	Added Warning for Outdoor Compressor Installation Location. Added Chiller configuration for Europe (Type C Configuration).

5	April 22, 2008	Addresses 13141069, 13150490, 13149049. Misc Correction of Ground Interconnect in Chapter 6, Chapter7, and Chapter8.
6	Mar 12, 2009	<p>'Pre-Installation Critical to Quality Checklist' renamed as 'Site Planning Reminders' and integrated in Chapter10.</p> <p>'Glossary' moved to Chapter12 Appendices.</p> <p>'HDe 1.5T System Catalog' was removed as customer architect would not access to sales order.</p> <p>'Magnetic Proximity Limits table' updated.</p> <p>Signa HDe 1.5T (Minimum Service Area): Added inch dimensions.</p> <p>'Customer Site Storage Requirements' updated.</p> <p>'Outdoor Unit for Type A Configuration', error was corrected.</p> <p>'Magnet and Enclosure': inch dimensions are added.</p> <p>'Magnet Mounting Detail' was simplified.</p> <p>Added dimension of Cryo cooler Compressor F-50</p> <p>Updated dimension of new GOC Computer Cabinet (OW1 A2)</p> <p>'Structural Steel Evaluation Of Proposed Sites' updated wording.</p> <p>'IEC EMC Compliance' updated</p> <p>Lighting was updated per system requirement.</p> <p>Chapter 7 Interconnects: updated.</p>
7	Feb 16, 2010	Updated Chapter 6, Section 4.2, Illustration 6-4: MR Magnet Room Grounding Requirements And Typical Diagram.

Table of Contents

Chapter 1 PRE-INSTALLATION INTRODUCTION.....	29
1 Pre-Install Manual Introduction.....	29
1.1 Document Purpose.....	29
1.2 Intended User.....	29
1.3 Document Overview.....	29
Chapter 2 SYSTEM CONFIGURATION.....	31
1 Basic System.....	31
1.1 Basic System.....	31
1.2 About BRM/LCS Chiller for Type A Configuration.....	36
2 Additional System Options.....	37
3 Facility Options.....	38
Chapter 3 ROOM LAYOUTS.....	39
1 Introduction.....	39
2 Proximity Limits.....	40
3 Room Sizes.....	41
4 Multiple MR Systems Site.....	43
4.1 Two Magnet Site Layout.....	43
4.2 Equipment Room Shared By Multiple MR Systems.....	44
4.2.1 Introduction.....	44
4.2.2 Equipment Cabinets Relative Locations.....	44
4.2.3 Penetration Panels Locations.....	46
4.2.4 System Cables Requirements.....	47
5 Delivery Route Requirements.....	49
5.1 Minimum Delivery Route Sizes and Capacity.....	49
5.2 BRM Gradient Coil Assembly, Cradle and Cart Delivery.....	51
6 MR System Interconnects Routing.....	52
7 Flooring.....	53
8 System Cooling Equipment Siting Considerations.....	54

- 8.1 System Cooling Equipment Configurations.....54
- 8.2 Water Chiller Siting Considerations for Type A Configuration.....55
 - 8.2.1 Water Chiller and MR System Interconnects.....55
 - 8.2.2 Water Chiller and MR System Separation Limitations.....56
- 8.3 Water Chiller Siting Considerations for Type B Configuration.....57
 - 8.3.1 Water Chiller and MR System Interconnects.....57
 - 8.3.2 Water Chiller and MR System Separation Limitations.....57
- 8.4 MRCC Siting Considerations.....59
 - 8.4.1 MRCC Interconnects/Separation Limitations.....59
 - 8.4.2 MRCC Access & Air Considerations.....59
 - 8.4.3 MRCC Outdoor Installation Mounting.....59
 - 8.4.4 Responsibility For Installation Tasks For MRCC Equipment.....59
- 9 Special Siting Considerations.....61
 - 9.1 System Cabinet Special Consideration.....61
 - 9.2 Blower Box (MG6).....70
 - 9.3 Pneumatic Patient Alert (PA1).....71
 - 9.4 Customer Site Storage Requirements.....72
 - 9.5 Oxygen Monitor Option.....74
 - 9.6 Magnet Monitor.....75
 - 9.7 System Monitoring and Support Connectivity.....76
 - 9.8 Outdoor Unit for Type A Configuration.....77
 - 9.8.1 About Flexible Gas Line.....77
 - 9.8.2 Outdoor Shield Cooler Compressor Wiring Diagram.....77
 - 9.8.3 Notification Of Water and Helium Lines Through The Wall.....80
 - 9.8.4 Notification Of Installation Location.....81
 - 9.8.5 Minimum Radius of Flexible Gas Line.....81
 - 9.8.6 Recommended Conduit for Outdoor Compressor Cable.....81
 - 9.8.6.1 For the 3 Conduits for the Power and Control Wiring.....81
 - 9.8.6.2 For the Conduit for the Input Power Wiring.....82
 - 9.9 TYPE C Chiller Configuration for Europe.....83
 - 9.9.1 CHILLER REQUIREMENTS FOR Type C CONFIGURATION (Europe Only).....83

9.9.1.1 SCOPE.....83

9.9.1.2 APPLICABLE DOCUMENTS.....83

 9.9.1.2.1 GOVERNMENT REGULATIONS.....83

 9.9.1.2.2 GE MEDICAL SYSTEMS AND SUPPLIER DOCUMENTS.....83

 9.9.1.2.2.1 COMPONENT DRAWINGS.....83

 9.9.1.2.2.2 INDUSTRY AND INTERNAL STANDARDS.....83

9.9.1.3 DEFINITION.....83

9.9.1.4 INTERFACE REQUIREMENTS.....83

 9.9.1.4.1 INPUTS.....83

 9.9.1.4.1.1 ELECTRICAL.....83

 9.9.1.4.1.2 MECHANICAL.....84

 9.9.1.4.2 REMOTE CONTROL PANEL.....84

 9.9.1.4.3 PROTECTION DEVICES.....84

 9.9.1.4.3.1 LEVEL SWITCH.....84

9.9.1.5 PERFORMANCE CHARACTERISTICS.....84

 9.9.1.5.1 COOLING.....84

 9.9.1.5.2 COOLANT SUPPLY SPECIFICATION (PRESSURE AND FLOW RATE).....85

9.9.1.6 PHYSICAL CHARACTERISTICS.....85

 9.9.1.6.1 SIZE.....85

 9.9.1.6.2 MASS.....85

 9.9.1.6.3 MOBILITY.....85

 9.9.1.6.4 ENVIRONMENTAL CONDITIONS.....85

 9.9.1.6.4.1 NON-OPERATING.....85

 9.9.1.6.4.2 OPERATING.....85

 9.9.1.6.5 DESIGN AND CONSTRUCTION.....86

 9.9.1.6.5.1 MATERIALS.....86

 9.9.1.6.5.2 ELECTROMAGNETIC COMPATIBILITY.....86

 9.9.1.6.5.3 SHOCK AND VIBRATION.....86

 9.9.1.6.5.4 SEISMIC REQUIREMENTS.....86

 9.9.1.6.5.5 PRODUCT MARKINGS AND IDENTIFICATION.....87

9.9.1.7 SAFETY/REGULATORY REQUIREMENTS.....	88
9.9.1.7.1 SAFETY REQUIREMENTS.....	88
9.9.1.7.1.1 NRTL.....	88
9.9.1.7.1.2 ACOUSTIC NOISE.....	88
9.9.1.7.2 SAFETY AND REGULATORY EVALUATIONS.....	88
9.9.1.7.2.1 HAZARD ANALYSIS.....	88
9.9.1.7.2.2 SAFETY/REGULATORY DESIGN REVIEW.....	88
9.9.1.7.2.3 REGULATORY LABELING.....	88
9.9.1.8 SUPPLIER QUALITY AND REGULATORY COMPLIANCE.....	88
9.9.1.8.1 SUPPLIER ROOT CAUSE/CORRECTIVE ACTION PROCESS.....	88
9.9.1.8.2 PURCHASE MATERIAL QUALITY REQUIREMENT.....	89
9.9.1.9 SERVICE REQUIREMENTS.....	89
9.9.1.9.1 ACCESS.....	89
9.9.1.9.2 PERIODIC MAINTENANCE.....	89
9.9.1.9.3 DOCUMENTATION AND FIELD SERVICE SUPPORT.....	89
9.9.1.9.3.1 OPERATOR DOCUMENTATION.....	89
9.9.2 Gradient Water Heat Exchanger (GWHX).....	90
9.9.2.1 POWER SPECIFICATION OF HEAT EXCHANGER.....	90
9.9.2.2 FRU for Heat Exchanger (2343325).....	90
9.9.2.3 Heat Output.....	90
9.9.2.4 Component Dimensions.....	91
9.9.3 Main Disconnect Panel (MDP) Requirements For Type C (Europe Only).....	92
9.9.4 General Information of Type C Configuration.....	96
9.9.4.1 Shipping Notice of Chiller.....	96
9.9.4.2 Minimum Room Size of Equipment Room.....	96
9.9.4.3 Air Cooling for Type C Configuration.....	96
9.9.4.4 Cooling Configuration for EU.....	96
9.9.4.5 INTERCONNECT DIAGRAM.....	97
10 Architectural Reminders.....	99
11 Floor Loading and Weights.....	101
11.1 MR System Components.....	101

11.2 Magnet and Dock Mounting.....	102
11.2.1 Magnet Installed With VibroAcoustic Damping Option.....	102
11.2.2 Magnet Installed Without VibroAcoustic Damping Option.....	103
12 Components Dimensions.....	104
12.1 Component Dimensions.....	104
12.2 Magnet and Enclosure.....	106
12.3 Shield/Cryo Cooler Compressor - For Type A.....	112
12.4 Shield/Cryo Cooler Compressor (Water Cooled) - For Type B.....	114
12.5 Shield/Cryo Cooler Compressor (Air Cooled) - For Type B.....	117
12.6 Main Disconnect Panel.....	118
12.7 MR Common Chiller (MRCC) for Type A Configuration.....	120
12.8 Water Chiller For System Cabinet - LCS (WC2) For Type A.....	123
12.9 Water Chiller For System Cabinet - MCS (WC2) for Type B.....	124
12.10 Water Chiller For BRM Gradient Coil (WC1) for TypeB.....	125
12.11 Blower Box.....	126
12.12 System Cabinet.....	127
12.13 Mesh Shield and System Cabinet Cover.....	129
12.14 Penetration Panel.....	130
12.15 Magnet Monitor.....	131
12.16 Patient Transport Table.....	132
12.17 Operator Workspace.....	134
12.18 Pneumatic Patient Alert.....	139
12.19 Magnet Rundown Unit.....	140
12.20 SPT Phantom Set Shipping/Storage Cart.....	141
12.21 DC Lighting Controller Option.....	142
12.22 Oxygen Monitor Option.....	143
Chapter 4 MAGNETIC FIELD CONSIDERATION.....	145
1 Introduction.....	145
2 Impact of Structural Steel.....	146
3 Structural Steel Evaluation Of Proposed Sites.....	147

4 Magnetic Shielding.....148

5 Magnetic Field.....149

 5.1 Fringe Field.....149

6 Exclusion Zone.....153

Chapter 5 SITE ENVIRONMENT.....155

 1 Introduction.....155

 2 IEC EMC Compliance.....156

 3 Temperature and Humidity Specifications.....157

 3.1 System Suite.....157

 3.2 MRCC Operating Environment.....157

 3.3 Outdoor Unit (CNA-61D-C) Operating Environment.....157

 4 Air Cooling.....158

 4.1 Requirements.....160

 4.2 Recommendations.....161

 5 Water Cooling.....162

 5.1 Gradient Coil Water Cooling.....162

 5.2 Gradient Coil Temporary Backup Water Cooling.....163

 5.3 Shield/Cryo Cooler Temporary Backup Water Cooling.....164

 5.4 Shield/Cryo Cooler Requirements For Site Provided Water Cooling.....165

 6 Altitude.....168

 7 Lighting.....169

 8 MR Suite Acoustic Specifications.....170

 8.1 Acoustic Specifications.....170

 8.2 Structureborne Acoustics.....170

 8.3 VibroAcoustic Damping Option.....170

 9 Room Ventilation.....171

 10 Cryogenic Venting.....174

 10.1 Cryogenic Venting Introduction.....174

 10.1.1 General Requirements.....174

 10.1.2 Vent Size - Pressure Drop.....174

10.2	Outside Magnet Room Requirements.....	175
10.2.1	Vent Support.....	175
10.2.2	Vent Construction.....	175
10.2.3	Vent Exit.....	175
10.2.4	1.5T LCC Magnet Cryogenic Vent System Pressure Drop.....	178
10.3	Inside Magnet Room Requirements.....	181
10.3.1	General Configuration.....	181
10.3.2	Vent Material.....	181
10.3.3	Vent Support.....	181
10.3.4	Vent Construction.....	181
11	Alarm Devices, Water Sensors and Thermostats.....	182
11.1	Water Sensor Alarm and Floor Drain.....	182
11.2	Pneumatic Patient Alert.....	182
12	Ambient Radio Frequency Interference (RFI).....	183
13	Pollution.....	184
14	Changing Magnetic Environment Specifications.....	185
14.1	Definition Of Moving Metal.....	185
14.2	Magnet Steel Objects Categories And Requirements.....	185
14.3	Distances For AC Power Lines, Transformers And Electric Motors.....	187
14.4	Sample Calculation Determine Minimum Distance From AC Power Lines, Transformers, And Electric Motors.....	189
15	Construction Materials.....	191
15.1	Magnet Room Floors Magnetic Properties.....	191
15.2	Walls, Ceilings, and Fixtures.....	191
15.3	Electrical conduits.....	192
15.4	Plumbing pipes and drains.....	192
15.5	Shield Cooler Compressor (Outdoor Type) Wall Penetration.....	192
16	Vibration.....	193
16.1	Types of Vibration Image Quality Issues.....	193
16.2	Site Planning Vibration Requirements.....	193
16.3	Vibration Specifications.....	193

16.3.1	Steady State Vibration Specifications.....	193
16.3.2	Transient Vibration.....	194
Chapter 6	POWER REQUIREMENTS.....	197
1	System Power Introduction.....	197
2	Critical Power Requirements.....	200
3	Power Distribution System.....	203
3.1	Main Disconnect Panel (MDP) Requirements.....	203
3.1.1	MDP for Type B.....	203
3.1.2	MDP for Type A.....	205
3.2	System Power Distribution Unit.....	210
4	Grounding.....	211
4.1	Facility Ground.....	211
4.2	System Ground.....	212
5	Ground Fault Protection.....	214
6	Power Source Monitoring.....	215
7	Emergency Power.....	216
8	DC Lighting Controller (Facility Option).....	217
Chapter 7	INTERCONNECT DATA.....	219
1	Introduction.....	219
1.1	Component Designators.....	219
1.2	Group Interconnects.....	220
1.3	Definition of Terms.....	222
2	Power Interconnects.....	225
3	Emergency Off Wiring.....	226
3.1	Introduction.....	226
3.2	Main Disconnect Panel Connections.....	226
3.3	Magnet Room Wiring.....	227
4	System Interconnects.....	228
4.1	System Interconnects General Information.....	228
4.2	Cable Groups Length Provided.....	229

- 4.3 L1 Interconnects.....231
- 4.4 L2 Interconnects.....233
- 4.5 L1 / L2 Interconnects.....236
- 4.6 L3 Interconnects.....238
- 4.7 L4 Interconnects.....239
- 4.8 L5 Interconnects.....241
- 4.9 Customer Supplied Interconnects.....243
- 4.10 Cable Group and Location Cross Reference.....246
- 5 MRCC Additional Interconnects.....250
 - 5.1 Interconnects For MRCC Option Located Outdoors.....250
 - 5.1.1 Vertical Separation Requirements.....250
 - 5.1.2 MRCC for Shield/Cryo Cooler Compressor: Water Cooling Lines & Hoses Requirements.....250
 - 5.1.3 RCP Data Cables Requirements.....250
 - 5.1.4 Power Wiring Requirements.....251
 - 5.1.5 System Additional Interconnects.....251
- 6 Contractor Furnished Components.....253
- 7 Oxygen Monitor Option Interconnects.....254
- Chapter 8 RF SHIELDED ROOM.....255**
 - 1 RF Shield Room Requirement.....255
 - 1.1 RF Shielding Background.....255
 - 1.1.1 Discrete Frequency.....255
 - 1.1.2 Broadband RF Noise.....255
 - 1.2 RF Shielded Room Requirements.....255
 - 2 Vents.....258
 - 2.1 Cryogenic Vent.....258
 - 2.2 Cryogenic Vent Location.....259
 - 2.3 Waveguide.....261
 - 2.4 Guide for Outside RF Room Isolation Joint.....262
 - 2.5 HVAC.....263
 - 3 Plumbing.....264

3.1 Water.....264

3.2 Medical Gases.....264

3.3 Sprinklers.....264

4 Electrical.....265

4.1 Facility Filter Ground Line.....265

4.2 Room Lighting.....265

5 RF Shield Consideration for System Cabinet and Penetration Panel.....266

6 Physical Considerations.....276

6.1 Introduction.....276

6.2 Doors and Other Openings.....277

6.3 Ceiling Height.....278

6.4 Walls.....280

6.5 Magnet Room Floors.....281

7 Anchor Hardware Requirements.....283

7.1 Anchor Hardware For MR Equipment Inside RF Shield.....283

7.1.1 Introduction.....283

7.1.2 Customer Responsibilities.....283

7.1.3 RF Shield Room Vendor Responsibilities.....283

7.1.4 GE Healthcare Responsibilities.....284

7.2 Physical Characteristics.....286

7.2.1 Anchor Requirements and Material Properties.....286

7.2.2 Design of Anchor Assembly.....286

7.3 Anchor Location And Installation.....291

7.4 Clamping Force (Tension) and Pull Test.....292

7.5 RF Shield Integrity.....293

7.6 Electrical Isolation.....294

7.7 Example - Select Magnet Anchor Size.....295

8 Magnet Room Equipment Mounting.....297

8.1 Magnet Rundown Unit (MS4).....297

8.2 Emergency Off Buttons.....297

8.3 Remote Oxygen Sensor Module (OM3) - Optional.....297

9 RF Door Switch.....	298
10 Emergency Exit.....	299
11 Room Ventilation Switch.....	300
Chapter 9 SHIPPING AND DELIVERY DATA.....	301
1 Shipment.....	301
2 Storage Requirements.....	303
3 Magnet Shipping Considerations.....	304
4 Cold-Shipped Magnet Deliveries.....	306
Chapter 10 SITE PLANNING REMINDERS.....	307
1 General Pre-Installation Reminders.....	307
2 Site Planning Reminders.....	308
2.1 Magnet Room Design and Construction.....	308
2.2 Required Before Magnet Delivery to Customer.....	310
2.3 Required Before Electronics System Delivery Customer.....	311
3 Typical MR Installation Project Schedule.....	312
Chapter 11 TOOLS AND TEST EQUIPMENT.....	313
1 Moving Metal Measurement Equipment.....	313
2 Rigger/Customer Supplied Equipment.....	314
3 Cryogenic Equipment.....	315
4 Installation Equipment.....	317
5 Test Equipment.....	319
6 Calibration Tools and Fixtures.....	320
7 Tool Kit.....	321
Chapter 12 APPENDICES.....	323
1 Glossary.....	323
2 MR Site Vibration Test Guidelines.....	326
2.1 Test Measurements.....	326
2.2 Equipment (Spectral Analyzer) Set-Up.....	326
2.3 Data Collection.....	326

2.3.1 Ambient Baseline Condition.....326

2.3.2 Normal Condition.....327

2.4 Presentation/Interpretation Of Results.....327

3 RF Shielded Enclosure Test Guidelines.....333

3.1 Introduction.....333

3.1.1 Purpose of Test Plan.....333

3.1.2 Not used.....333

3.2 Applicable Documents.....333

3.3 Test Sample Set-Up.....333

3.4 Shielding Effectiveness.....333

3.5 Measurement Procedure.....334

3.5.1 Test Position.....334

3.5.2 Frequency Range.....334

3.5.3 Free Field Calibration.....334

3.6 Enclosure Power Reference Isolation.....334

3.7 Test Equipment.....335

3.8 Data Recording and Verification.....335

3.9 Test Report.....335

4 Acoustic Design Guidelines.....336

4.1 Magnet Room.....336

4.2 Inter-Spatial Areas.....336

4.2.1 Wall Construction.....336

4.2.2 High Bay RF Room.....338

4.2.3 Miscellaneous Plumbing, RF Windows and RF Doors.....338

Chapter 1 Pre-Installation Introduction

1 Pre-Install Manual Introduction



WARNING

PERSONNEL INJURY OR EQUIPMENT FAILURE
FAILURE TO IMPLEMENT ALL REQUIREMENTS AND ADHERE TO ALL SPECIFICATIONS IN THIS MANUAL MAY RESULT IN PERSONAL INJURY, EQUIPMENT DAMAGE, SCAN FAILURE, OR WARRANTY VOID.

THE IMPLEMENTATION OF ALL REQUIREMENTS AND ADHERENCE TO ALL SPECIFICATIONS IN THIS MANUAL IS THE RESPONSIBILITY OF THE CUSTOMER OR THEIR ARCHITECT AND ENGINEERS. REFER ANY QUESTIONS TO THE GE HEALTHCARE PROJECT MANAGER OF INSTALLATION (PMI).



NOTICE

The site must comply with all local and National codes and regulations.

1.1 Document Purpose

This pre-installation manual provides the necessary information to prepare a site for system installation. Specifically, this manual provides information:

1. For the site to meet system requirements
2. For the effective arrangement and interconnection of system components

1.2 Intended User

The primary user of this manual is the installation or architectural planner who has knowledge of the following:

1. MR nomenclature, system functions, and general characteristics
2. National and local building codes
3. Customer site procedures (medical, MR, safety, etc.)
4. Any special architectural requirements (e.g., seismic codes)

1.3 Document Overview

This manual describes requirements and specifications for the following:

1. General System Requirements
2. Shipping and Delivery
3. Magnet Room
4. Equipment Room

5. Control Room
6. Interconnects

Chapter 2 System Configuration

1 Basic System

1.1 Basic System

The basic Signa HDe 1.5T system for fixed site operation consists of the following major equipment:

- 15 kilogauss (1.5T) LCC Magnet with Magnet Enclosure and Magnet Accessories
- Shield/Cryo Cooler Compressor Cabinet
- Body Gradient (BRM) and RF body coils and 1.5T Quad Head Coil
- Blower Box provides Body Coil cooling air and air to the Patient Comfort Module in the Magnet Enclosure.
- System Cabinet:
 - HFD/PDU Cabinet containing High Fidelity Drivers and Power Distribution Unit module with unregulated transformer 200/208/380/400/415/480 Volt, 50/60 Hz with power filter
 - 1.5T RF Amplifier
 - Multi Generational Data Acquisition (MGD) chassis
 - DCERD2 chassis with EXCITE 4 or 8 Channels
 - Driver Module
- Penetration Panel
- Water Cooling Systems for Type A System Configuration
 - MRCC (Chiller for BRM and LCS) (WC1). Refer to [Section 1.2](#)
 - Cooling Unit for System Cabinet(LCS) (WC2)
- Water Cooling Systems for Type B System Configuration
 - Water Chiller for BRM (WC1)
 - Cooling Unit for System Cabinet (MCS) (WC2)
- Shield Cooler Compressor for Type A Configuration

Note 1: There are two types of Outdoor Air Cooled Shield/Cryo Cooler Cabinet for Type A Configuration. Select one according to the catalog.

 - CNA-61C for 200V: Composed of Outdoor Unit and Indoor Unit
 - CNA-61D for 380, 400, 415, 460, and 480 V: Composed of Outdoor Unit and Indoor Unit

Note 2: Regarding the Flexible Gas Line, refer to [Chapter 3, Outdoor Unit for Type A Configuration](#).
- Shield Cooler Compressor for Type B Configuration

Note: There are two types of Shield Cooler Compressor for Type B Configuration. Select one according to the catalog.

 - Air Cooled Indoor Shield Cooler Compressor for 200V
 - Water Cooled Indoor Shield Cooler Compressor for 380, 400, and 415V
- Operator Workspace equipment: GOC Computer Cabinet with Linux PC, SCIS Tower, Mouse and Mouse Pad, LCD panel, and chair
- Pneumatic Patient Alert System
- Patient Transport Table and cradle

Note: Refer to HDe 1.5T System Catalog in this section.

- Signa Standard Table
- Signa Lite Table
- Main Disconnect Panel (MDP): GE pre-engineered unit to be ordered and utilized or customer supplied MDP which meets requirements ([see Chapter 6, Main Disconnect Panel \(MDP\) Requirements](#)) can be considered dependent on flowchart information in .
- Patient accessories such as: a phantom kit, patient log book, head cushion and sponges, chin and forehead straps, body wedges, knee cushions, and security/restraint straps
- Gating accessories which include: patient cardiac leads, peripheral gating probe, and respiratory bellows

[Illustration 2-1](#) shows the major equipment of the system without Equipment Room. [Illustration 2-2](#) shows the major equipment of the system with Equipment Room. The flowcharts in list the catalogs which comprise the Signa HDe 1.5T system.

Illustration 2-1: Signa HDe 1.5T System without Equipment Room (Type A)

Type A

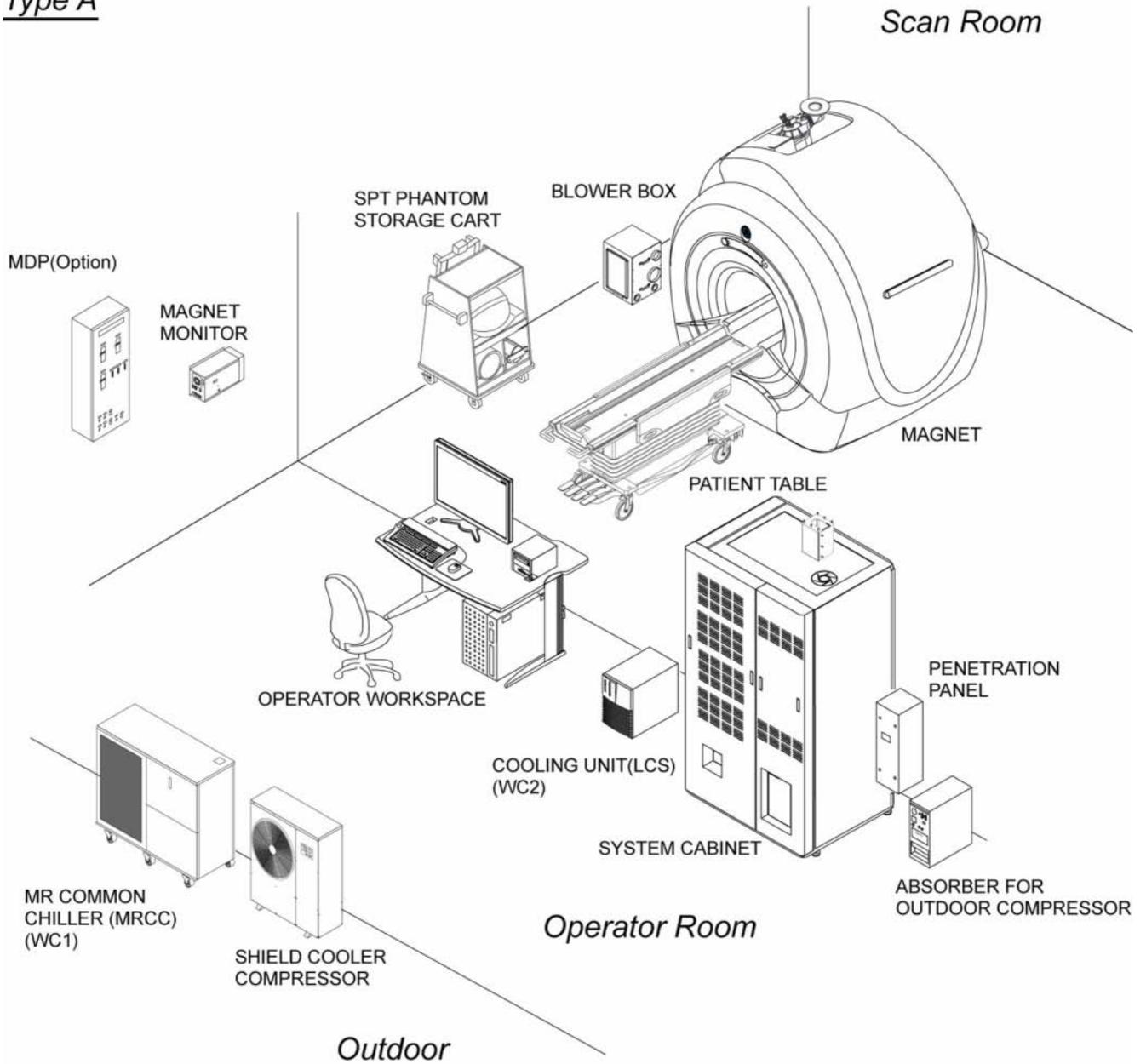


Illustration 2-2: Signa HDe 1.5T System with Equipment Room (Type B)

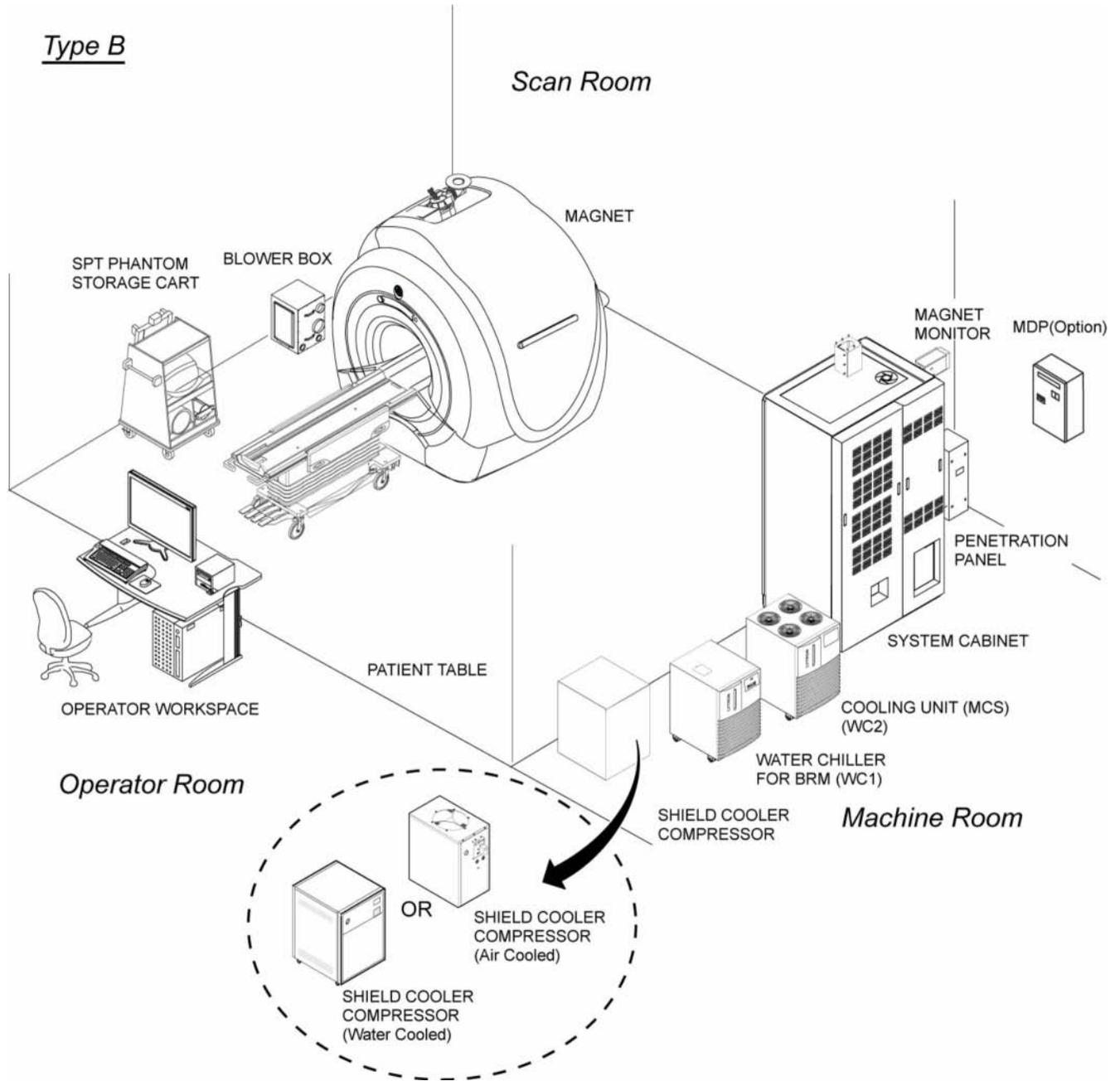
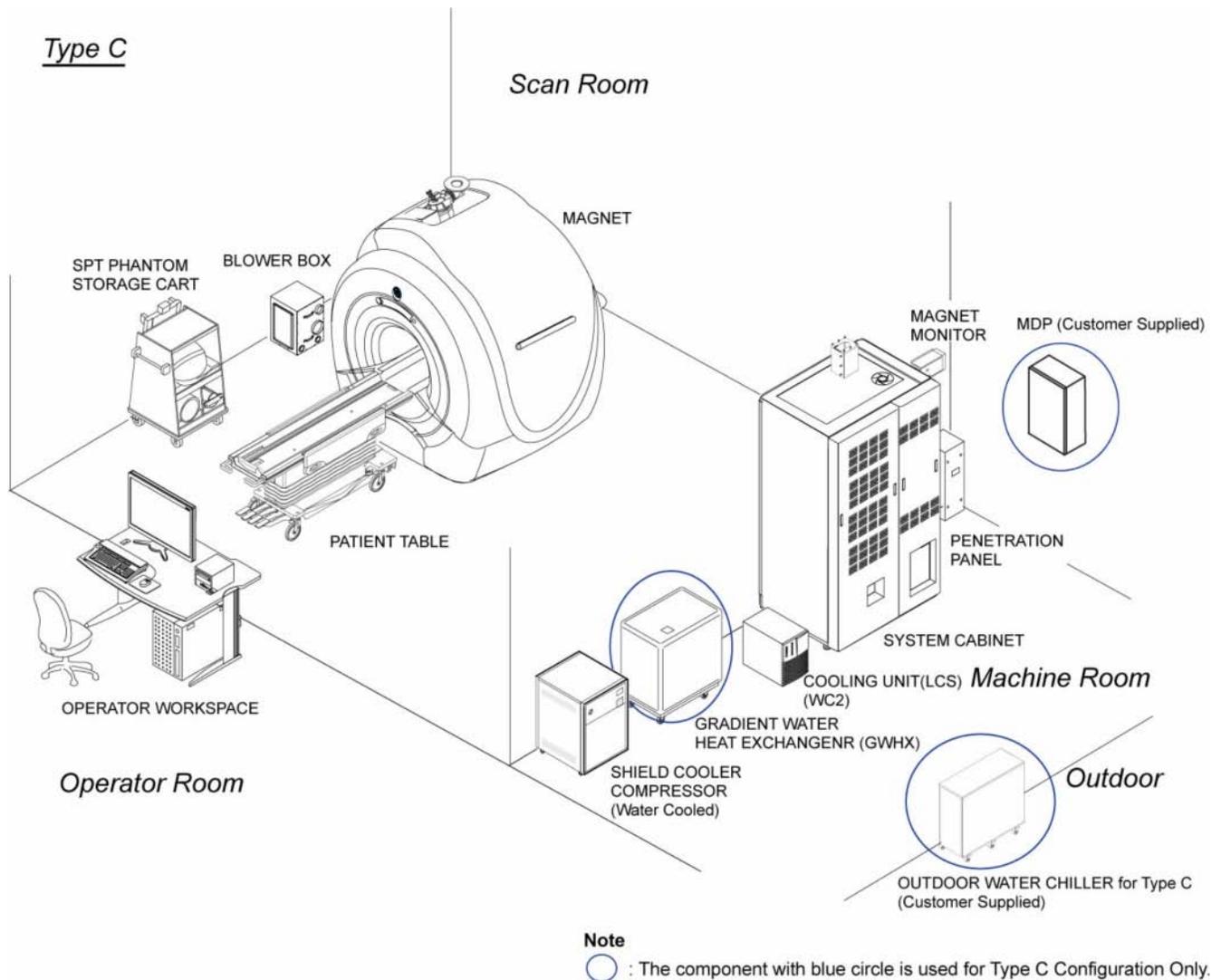


Illustration 2-3: Signa HDe 1.5T System with Equipment Room (Type C) - Europe Only



NOTE: Type C configuration for Europe Only. Refer to for HDe 1.5T System Catalog - Europe.

The following components are used for Type C configuration Only.

- **Outdoor Water Chiller for Type C:** Refer to [Chapter 3, CHILLER REQUIREMENTS FOR Type C CONFIGURATION \(Europe Only\)](#).
- **Gradient Water Heat Exchanger (GWHX):** Refer to [Chapter 3, Gradient Water Heat Exchanger \(GWHX\)](#).
- **MDP for Type C,** refer to [Chapter 3, MDP Requirement for Type C](#).

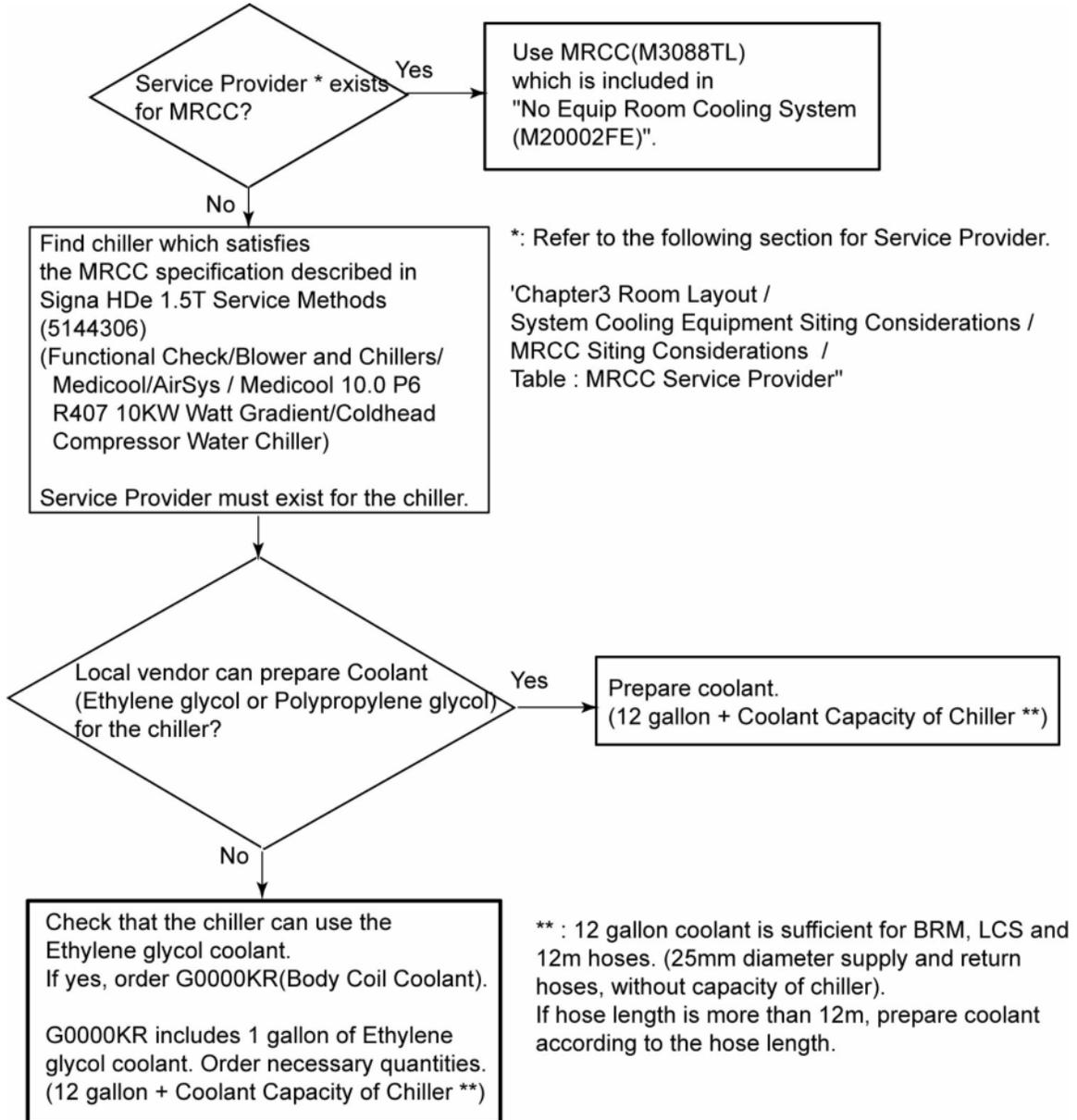
For general information of for Type C Configuration, refer to [Chapter 3, General Information of for Type C Configuration](#)

NOTE: Contact your local GE Healthcare Project Manager about local supplied chiller.

1.2 About BRM/LCS Chiller for Type A Configuration

Following Flow Chart shows the Chiller for Type A Configuration. Refer to [Chapter 3, MRCC Siting Considerations](#) for MRCC Service Provider.

Illustration 2-4: Chiller for Type A Configuration



2 Additional System Options

This section lists options for the MR system which have site preparation impact not included in [Basic System](#).

- The VibroAcoustic Damping Option (M1060MA) provides a method to reduce the probability of acoustic structureborne transmission throughout the customer facility.
- Advantage Workstation (AW)

NOTE: LCD monitor is recommended for a AW to be located near the Signa system Operator Workspace due to gauss field proximity limits.

- Other hard copy devices and patient accessories.
- Cryogen refill service.
- Various GE Healthcare Service contracts.

3 Facility Options

- Signa System Seismic Anchorage Service (R4390JA).
- Signature 5000 Series 3 UPS 100KVA (E4502FB) provides reliable, clean, constant voltage power for the complete MR system. The use of a full system UPS enables the system imaging to be completed after loss of supply power and allows for saving of valuable data and orderly system shutdown. Also recommend installing a 100KVA UPS Bypass Panel (E4504CG) which feeds power to the UPS in the normal mode and enables the imaging system to operate when the UPS is in manual bypass mode for routine servicing of the UPS.
- Direct current (DC) lighting controller for the magnet room:
 - E4503AD 20 Amp Maximum Constant Lighting Level System, surface/semi-flush mount
 - E4503AF 20 Amp Maximum Variable Lighting Level System, surface/semi-flush mount
 - E4503AW 28 Amp Maximum Constant Lighting Level System, surface/semi-flush mount
 - E4503AY 28 Amp Maximum Variable Lighting Level System, surface/semi-flush mount.
- Oxygen Monitor Kit (M1060KM) which includes Oxygen Monitor and Remote Oxygen Monitor Module.

NOTE: The Oxygen Monitor does not bear a CE monogram and therefore may not be acceptable in all European countries.

Chapter 3 Room Layouts

1 Introduction

When laying out a floor plan there are special considerations that must be taken into account due to the magnetic field effect on certain medical implants (including cardiac pacemakers, neurostimulators, and biostimulation devices) and the environmental effect (motors, steel, etc.) on the field homogeneity. The maximum magnetic field in which the equipment can be located is listed in [Proximity Limits](#). Selected magnetic shielding of some devices and equipment is possible but must be handled on an individual basis. Refer to [Chapter 7, Cable Groups Length Provided](#) for cable length considerations.

The RF shielded room (Magnet Room) is unique in that the room must be shielded from outside radio frequency interference. This is done by enclosing the room with metal walls, floor and ceiling. These shielding requirements impose special considerations which are addressed in RF Shielded Room chapter sections beginning with [Chapter 8, RF Shield Room Requirement](#).

The Magnet Room can be magnetically shielded to reduce the magnet fringe field or to shield the magnet from the effects of the external environment. Refer to [Chapter 4, Magnetic Shielding](#) for magnet shielding considerations.

2 Proximity Limits

The table below lists stationary equipment known to be sensitive to high magnetic fields. The table is provided as a guide only. Actual Gauss limits are equipment specific and must be determined during the site planning process. Refer to [Chapter 4, Magnetic Field](#) to define the magnetic field plots. Also refer to [Chapter 5, Changing Magnetic Environment Specifications](#) for requirements for moving object sensitivity, including automobiles, elevators cages, etc.

Table 3-1: Magnetic Proximity Limits

Gauss (mT) Limit	Equipment		
0.5 gauss (0.05mT)	Nuclear camera		
1 gauss (0.1mT)	Positron Emission Tomography scanner	Video display (tube)	
	Linear Accelerator	CT scanner	
	Cyclotrons	Ultrasound	
	Accurate measuring scale	Lithotripter	
	Image intensifiers	Electron microscope	
	Bone Densitometers		
3 gauss (0.3mT)	Power transformers	Main electrical distribution transformers	
5 gauss (0.5mT)	Cardiac pacemakers	Biostimulation devices	
	Neurostimulators		
10 gauss (1mT)	Magnetic computer media	Telephone switching stations	
	Hard copy imagers	Water cooling equipment	
	Line printers	HVAC equipment	
	Video Cassette Recorder (VCR)	Major mechanical equipment room	
	Film processor	Credit cards, watches, and clocks	
	X-ray tubes		
	Large steel equipment, including:		
	Emergency generators	Air conditioning equipment	
	Commercial laundry equipment	Fuel storage tanks	
	Food preparation area	Motors greater than 5 horsepower	
50 gauss (5mT)	System Cabinet (Pen Panel Side)	Metal detector for screening	
	GOC	Telephones	
	LCD panels		
200 gauss (20mT)	Penetration Panel	Blower Box	
No Limit	Digital Detectors		
Note: Recommended limits given above are based on general MR site planning guidelines. Actual susceptibility of specific devices may vary significantly depending on electrical design orientation of the device relative to the magnetic field and the degree of interference considered unacceptable.			

3 Room Sizes

Table 3-2 contains minimum room dimensions necessary for an MR suite and issues which are created by reduction in service access, operator access, and equipment space.

Table 3-2: System Minimum Room Inside Clear Space Dimensions

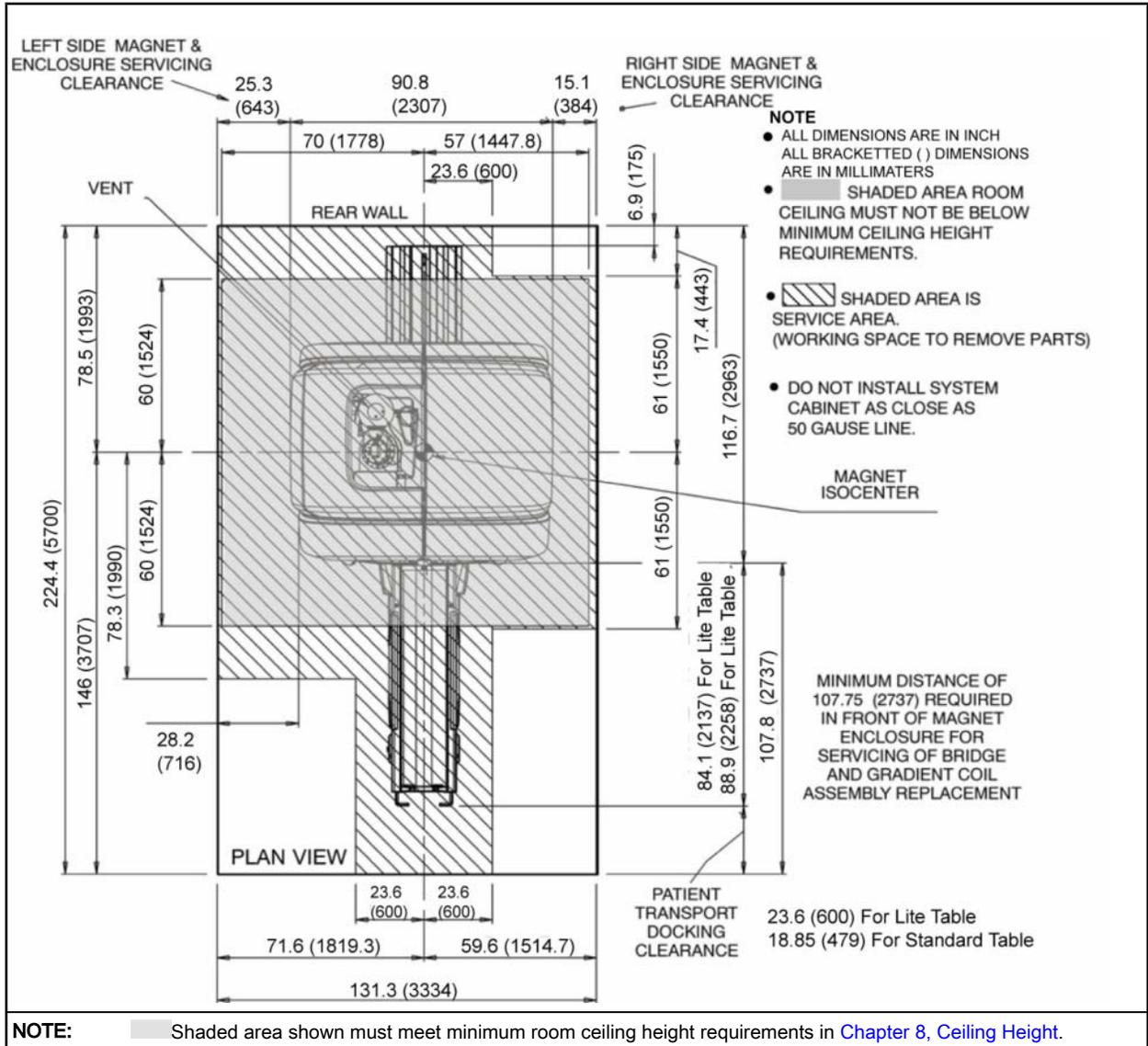
System Configuration	Equipment Room Finished Minimum Values		Magnet Room Finished Minimum Values			Control Room Finished Minimum Values		Total System Area ft ² (m ²)
	See Note 6 & 7		See Note 4			See Note 7		
	W x D ft-in. (m)	Area ft ² (m ²)	W x D ft-in. (m)	Area ft ² (m ²)	Ceiling Height ft-in. (m)	W x D ft-in. (m)	Area ft ² (m ²)	
System without Machine Room (with Outdoor Cryo compressor and MRCC)	N/A	N/A	11.0 X 18.7 (3.334 x 5.7) See Note 1, 2, 3, 5	205.7 (19.0)	8-9 (2.67) See Note 8	11.0 x 6.23 (3.334 x 1.9)	68.53 (6.335)	272.78 (25.34)
System with Machine Room (with Indoor Cryo compressor and water cooling unit)	8.9 x 8.2(2.7 x 2.5)	73.0 (6.75)				5.0 x 7.0 (1.52 x 2.13)	35 (3.252)	313 (29.00)

Note

* Width is dependent on Magnet Room door location and customer's approval of limited space available for operator.

1. Must locate center of the magnet to keep minimum area described in [Table 3-3](#).
2. Minimum dimensions dependent on the magnetic field containment requested and dimensions of magnetic shield design.
3. Room dimensions in front of LCC Magnet MUST allow for Gradient Coil Assembly and split bridge installation/servicing. The LCC Magnet MUST USE special Gradient Coil Replacement Tool Kit for replacing the Gradient Coil Assembly. The Gradient Coil Replacement Tool Kit is shipped in a wooden crate on casters. Utilization of Gradient Coil Replacement Tool requires 107.75 in. (2737 mm) clear space in front of magnet. Note split bridge servicing requires 77.5 in. (1969 mm) clear space in front of the magnet.
4. Absolute Minimum Magnet Room dimensions will result in limited operator clearances and increased Magnet Service time. [Table 3-3](#) shows only 1.5 ft (0.46 m) clearance at end of Patient Transport.
5. Room dimensions do not contain 5 gauss line to room.
6. Equipment Room contents for the listed dimensions include System Cabinet, Shield/Cryo Cooler Compressor Cabinet, MDP, Magnet Monitor. The minimum room dimensions do not permit space for any optional equipment such as Advantage Workstation, Laser Camera, etc.
7. Minimum Equipment Room and Control Room dimensions do not permit placement of air conditioning units in the room.
8. Magnet Room minimum ceiling height is 8 ft 2.5 in. (2.50 meter) when Low Ceiling Height Siting Option (M1060SR) is installed. Refer to [Chapter 8, Ceiling Height](#).
9. System Cabinet must be placed farther than 50 gauss line from the magnet.

Table 3-3: Signa HDe 1.5T (Minimum Service Area)

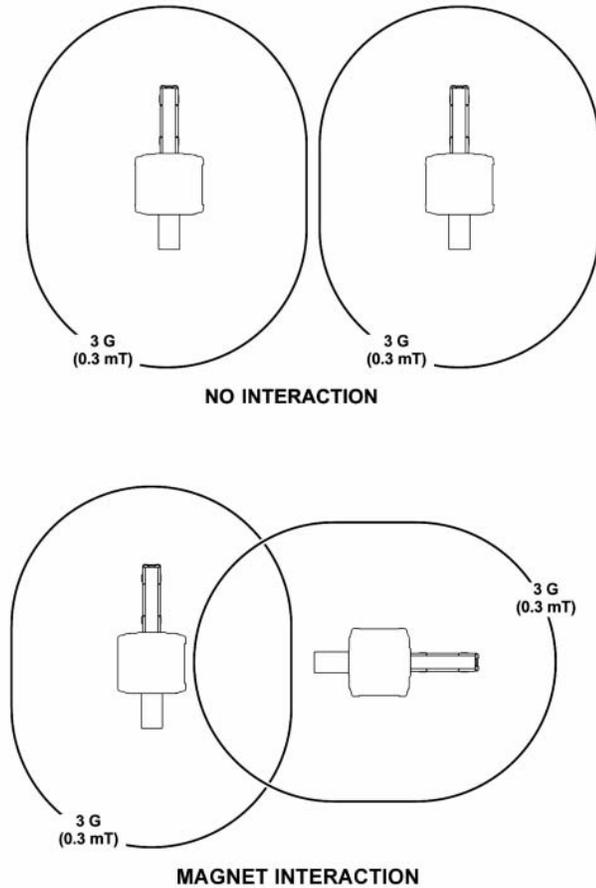


4 Multiple MR Systems Site

4.1 Two Magnet Site Layout

Sites planning to install multiple magnets, independent of the MR supplier, must ensure the 3 gauss lines of each magnet do not cross. Crossover of one MR magnets 3 Gauss line into another MR magnet 3 gauss line will result in service or down time for both machines when shim or magnet ramps are performed.

Illustration 3-1: Two Magnet Installation



4.2 Equipment Room Shared By Multiple MR Systems

4.2.1 Introduction

When the Equipment Room is shared by more than one MR system of the same field strength there is a potential for cross-talk of RF energy between the MR systems. RF cross-talk may cause noise artifacts in images. Proper planning and installation of the multiple systems in the shared Equipment Room can reduce the potential for cross-talk.

The potential for cross-talk exists when the RF transmit cables and equipment of two or more MR systems are located in the same Equipment Room. For example, when one system is transmitting, the other system could be in receive mode and therefore pick up the RF energy being transmitted resulting in a cross-talk scenario.

NOTE: The potential for cross-talk exists for RF transmit cables and equipment that produces RF that are part of a non-GE MR System of the same field strength.



NOTICE

The RF Screen of the Magnet Room for each system needs to meet the RF Attenuation specifications in [Chapter 8, RF Shielded Room Requirement](#).

The following subsections provide requirements for shared Equipment Room design, layout, and installation which reduce the potential for RF cross-talk.

4.2.2 Equipment Cabinets Relative Locations

The following are requirements for locating equipment cabinets of one MR system relative to the other MR system equipment cabinets.

- Maximize separation distance between the RF transmitter (RF Amplifier) of one MR system and the RF receiver (DCERD2 Chassis/RRF Chassis) of the other MR system of the same field strength.
- The RF transmitter (RF Amplifier) of one MR system and the RF receiver (DCERD2 Chassis/RRF Chassis) of the other MR system of the same field strength must be separated by a minimum of > 6.6 feet (2 meters) in all directions, see [Illustration 3-2](#) and [Illustration 3-3](#).
- Signa HDe 1.5T RF Amplifier and the DCERD2 Chassis are both located in the System Cabinet.

NOTE: Relative placement should not be an issue for chillers, compressors, and other non-RF Transmit/Receiver MR System equipment.

Illustration 3-2: Multiple Signa HDe 1.5T Systems & Signa EXCITE 1.5T (Release 12.x) Electronics Cabinets Spacing

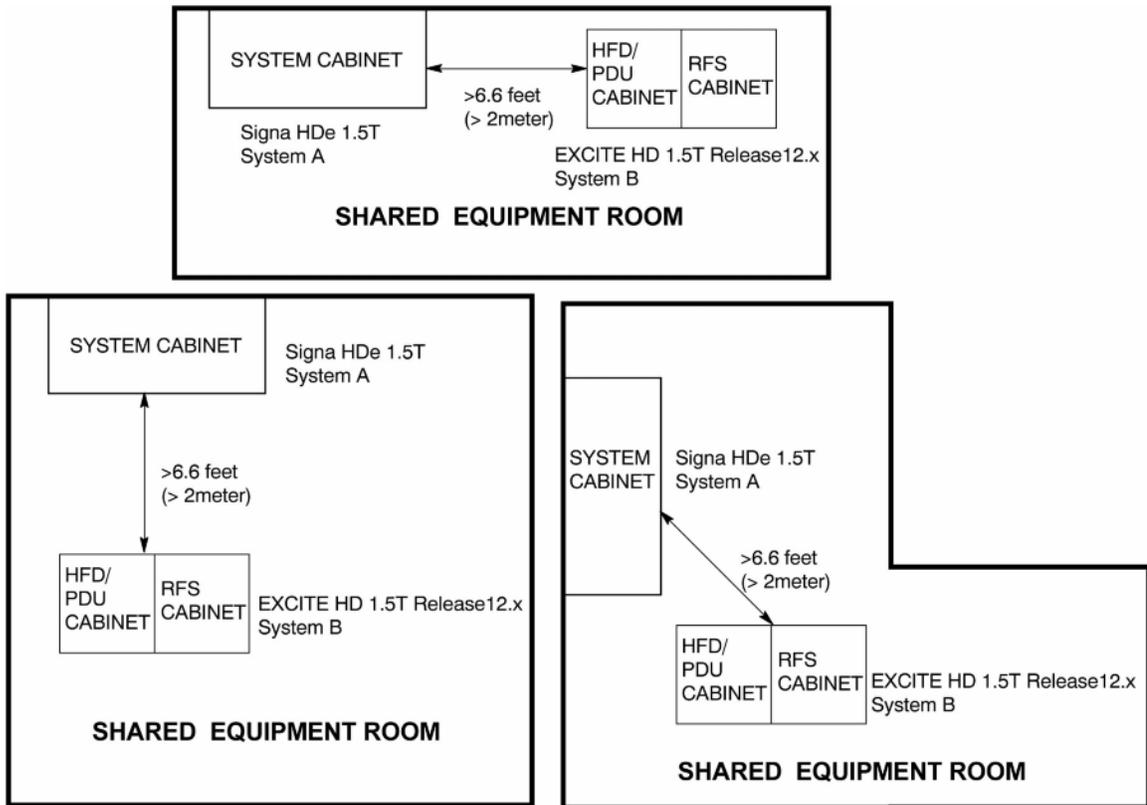
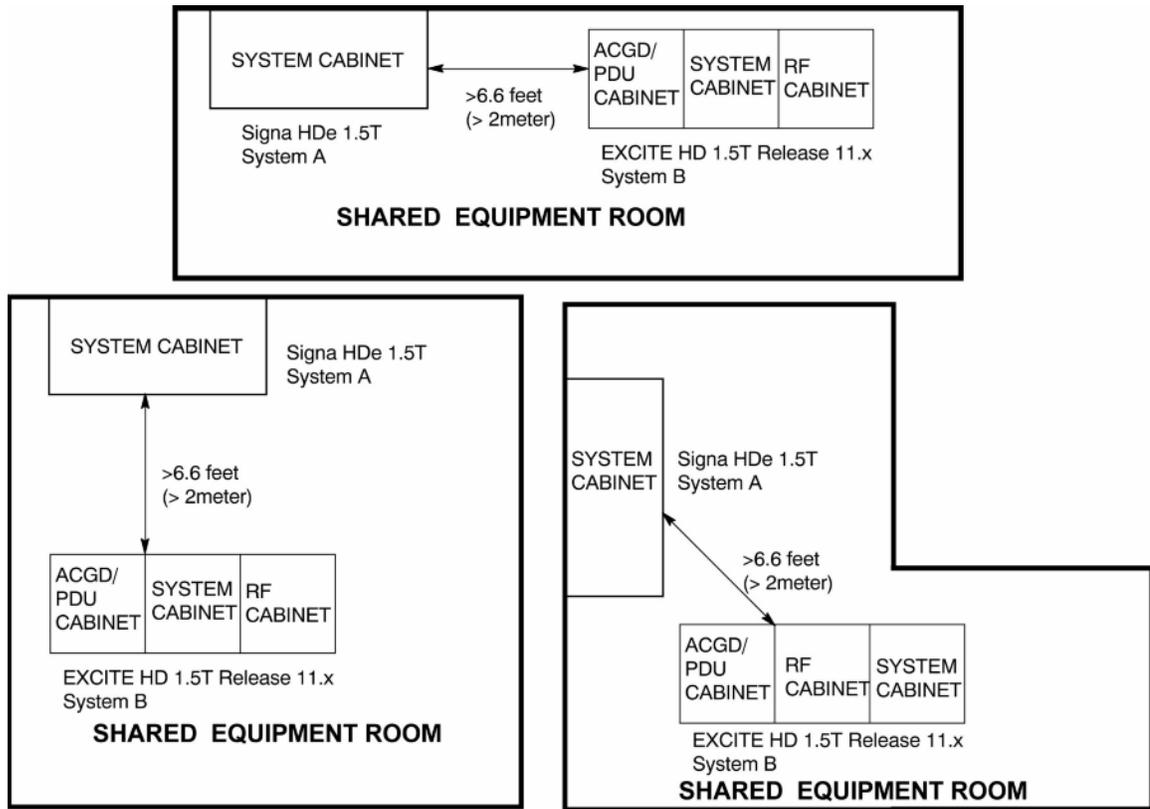


Illustration 3-3: Multiple Signa HDe & Signa EXCITE 1.5T (Release 11.x) Systems Electronics Cabinets Spacing

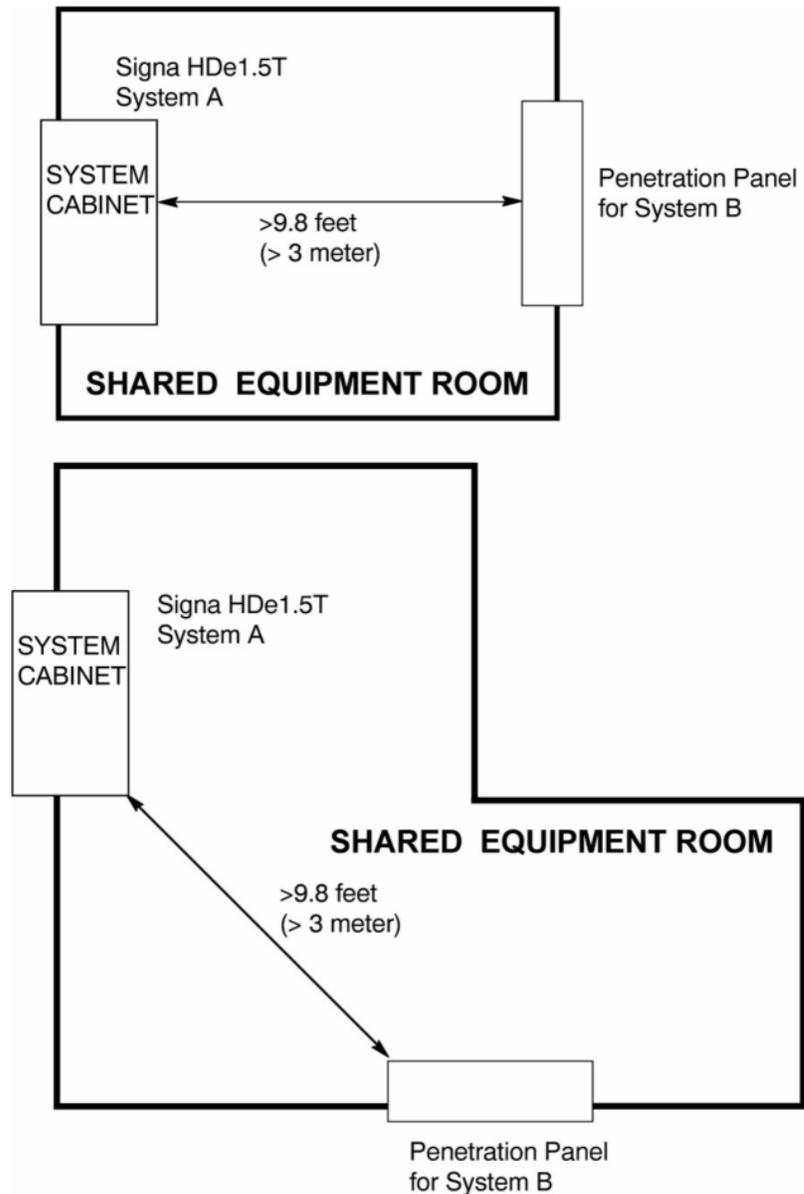


4.2.3 Penetration Panels Locations

The following are requirements for locating the RF Shielded Room Penetration Panel and System Cabinet of one MR system relative to the other MR system RF Shielded Room Penetration Panel and System Cabinet.

There must be > 9.8 feet (3 meters) separation between the Penetration Panels and System Cabinet of each system sharing the Equipment Room space, see [Illustration 3-4](#).

Illustration 3-4: Multiple MR Systems Penetration Panel Spacing

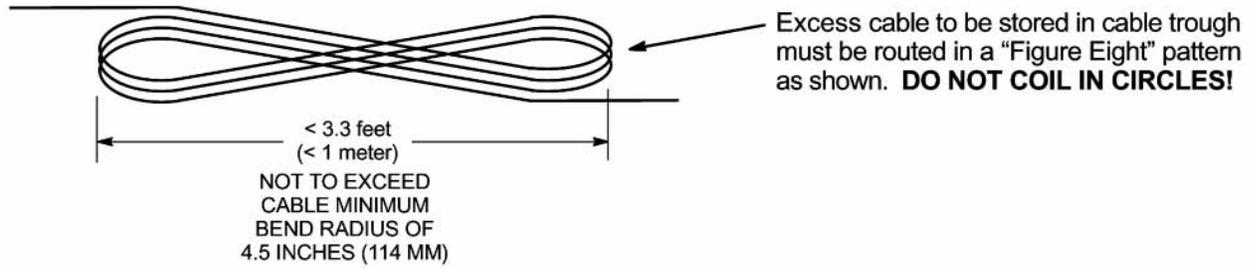


4.2.4 System Cables Requirements

The following are requirements for locating and managing excess RF Receive and Transmit cables of the MR systems sharing the Equipment Room.

- There must be > 6.6 feet (2 meters) separation between the system interconnect cables of each system sharing the Equipment Room space.
- Receive cables excess length must be stored in a "figure 8" with overall dimension of <3.3 feet (<1 meter), see [Illustration 3-5](#).

Illustration 3-5: Proper Storage Of Excess Receive Cables



5 Delivery Route Requirements

5.1 Minimum Delivery Route Sizes and Capacity

Table 3-4 lists minimum actual clearance opening dimensions for doors and hallways required by the MR system equipment. Installation or replacement of components listed in Table 3-5 must be taken into consideration when determining hallway and door dimensions. Clearance for maneuvering around corners or turns must also be taken into consideration. Refer to Chapter 9, Shipment for Signa Component shipping dimensions.

Table 3-4: Minimum Hallway/Door Dimensions

Component	Minimum Hallway/ Door Width*		Minimum Hallway/ Door Height*		Comments
	in.	mm	in.	mm	
Operator Workspace Table	32	813	80	2032	
System Cabinet	39	1000	80	2032	
Cryogen delivery route and Storage Room	43	1092	80	2032	Width requirements due to size of 500 liter dewars. Width and height requirements vary dependent on the dewars used. Check with cryogen supplier.
LCC Magnet	Refer to Note 1		Refer to Note 1		Refer to Table 3-5 for uncrated magnet dimensions.
RF Room Door	Chapter 8, Doors and Other Openings				
<p>Note * Minimum hallway and door dimensions are actual clearance openings. Width and height of rigging equipment is not included in above dimension.</p> <p>1. Minimum width depends on access route to removable panels of RF shielded room wall. For straight path (i.e. no bends or turns) recommended to allow 6 in. (153 mm) on both sides of magnet. Appropriate calculations must be performed if turns exist along proposed magnet delivery route. Illustration 3-6 shows dimensions for 90° turn.</p> <p>2. Final dimension is dependent on rigger equipment used, refer to Chapter 9, Magnet Shipping Considerations.</p>					

Illustration 3-6: LCC Magnet Minimum Door/Hallway Dimensions 90° Turn

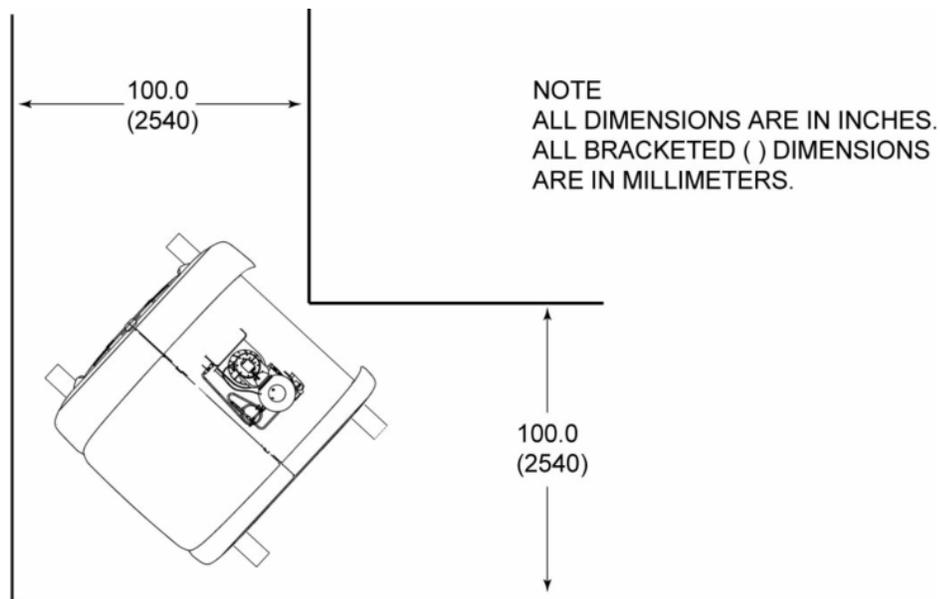


Table 3-5: Component Dimensions For Installation/Replacement

Component	Approximate Weight lbs (kg)	Overall Dimensions W x D x H in. (mm)	Comments
Magnet (uncrated)	Refer to comments.	Refer to comments.	Refer to Chapter 9, Magnet Considerations for dimensions, illustrations and weights.
Split Bridge	40 (18)	21.5 x 77.3 x 7 (546 x 1969 x 177.8)	Room dimensions in front of the Magnet MUST allow for bridge installation/servicing and Gradient Coil Replacement, See Note 3.
Replacement RF Body Coil	155 (70)	30 x 30 x 60 (762 x 762 x 1524)	Replacement coil is shipped in a protective case. Weight & dimensions are for coil & case.
Replacement BRM Gradient Coil Assembly on a Shipping Cradle/Cart	See Note 1	35 x 96.09 x 55.88 (889 x 2441 x 1420) See Note 2 & 3	Initial BRM Gradient Coil Assembly is shipped installed in the Magnet. Shipping/installation cart is used to install replacement coil assembly only. Refer to Gradient Coil Assembly, Cradle and Cart Delivery Requirements
Gradient Coil Replacement Tool Kit Crate	750 (340)	30 x 86 x 28 (762 x 2184 x 711)	See Note 3.
System Cabinet	2206 (1000)	40 x 31x 79 (1000 x 800 x 1995)	
<p>Note</p> <ol style="list-style-type: none"> The replacement BRM Gradient Coil Assembly weight is approximately 2300 lbs (1045 kg), the shipping cradle is 132 lbs (60 kg), and the Gradient Coil Assembly shipping/installation cart weighs 855 lbs (389 kg). Therefore total shipping weight is 3287 lbs (1491 kg). The coil assembly outside diameter x length dimensions are 35.1 x 73.5 in. (892 x 1867 mm). For illustrations of coil/cradle/cart refer to BRM Gradient Coil Assembly, Cradle and Cart Delivery Gradient Coil Assembly and shipping cart dimensions are with cart in lowest position. Cart can be adjusted to maximum height of 61.88 in. (1572 mm). The LCC Magnet MUST USE GE Service Tool Gradient Coil Replacement Kit for replacing the Gradient Coil Assembly. The Gradient Coil Replacement Tool Kit is shipped in a wooden crate on casters. Utilization of Gradient Coil Replacement Tool requires 107.75 in. (2737 mm) clear space in front of magnet. 			

5.2 BRM Gradient Coil Assembly, Cradle and Cart Delivery

Initial BRM Gradient Coil Assembly is shipped installed in the Magnet. Shipping/installation cart is required to be used to install replacement coil assembly. The Gradient Coil Assembly will be delivered on an aluminium (re-useable) cradle. A forklift or crane/hoist rated for 4000 lbs (1818 kg) may be required to position the coil/cradle assembly onto the cart for installing the coil into the magnet, see [Illustration 3-7](#) and [Illustration 3-8](#).

Illustration 3-7: Replacement BRM Gradient Coil Assembly & Cradle

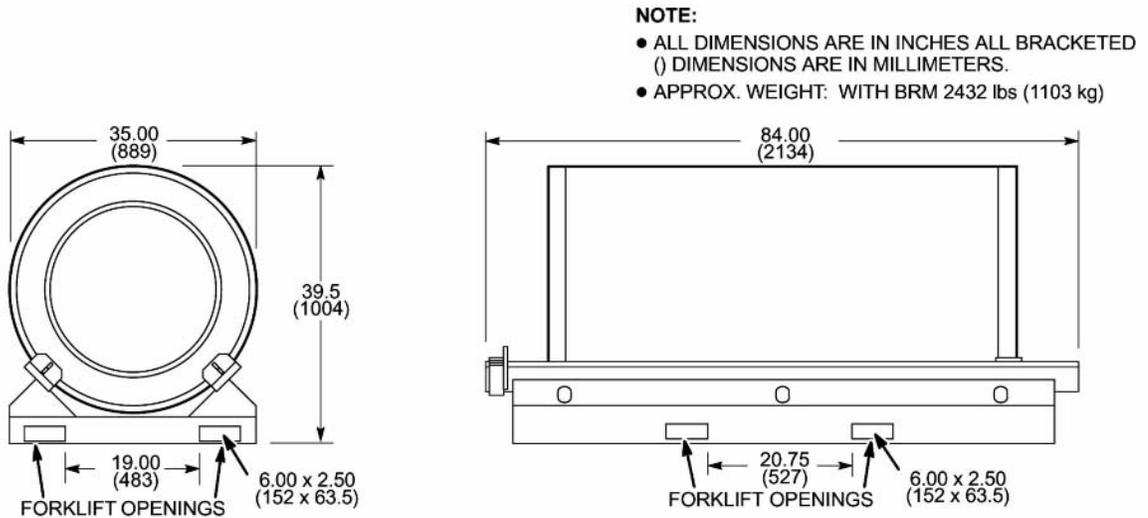
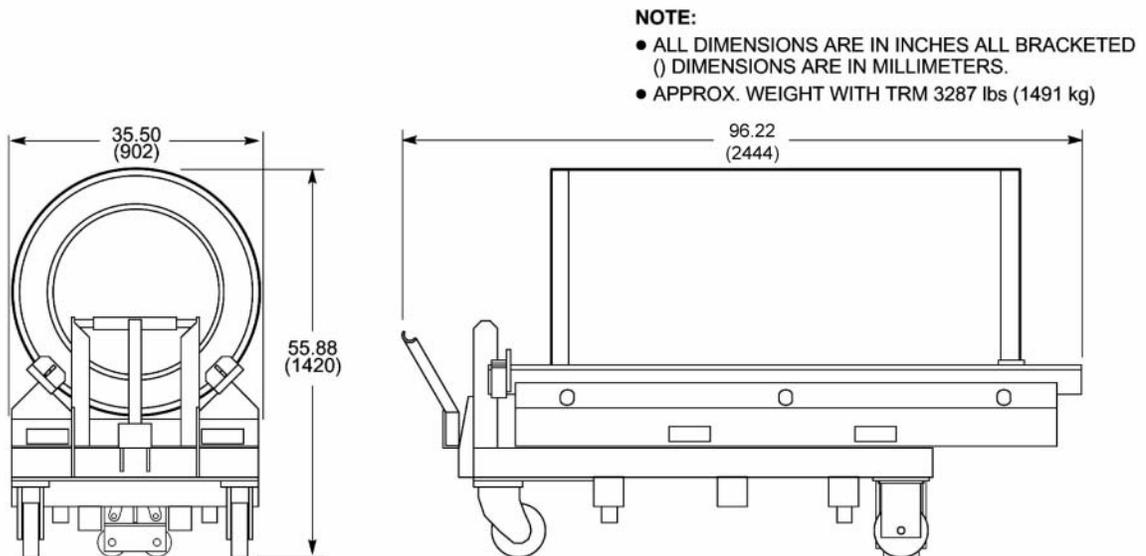


Illustration 3-8: Short Room Replacement BRM Gradient Coil Assembly & Cradle On Cart



6 MR System Interconnects Routing

The customer, architect/consultant, and contractor must consider the design/method for routing the MR system interconnects to minimize potential adverse performance impact. Refer to [Table 3-6](#) for MR system interconnects routing requirements and recommendation.

Table 3-6: MR System Interconnects Routing Requirements/Recommendations

Area	Requirements	Recommendations
Entire MR System	<ol style="list-style-type: none"> 1. Cable routing throughout the system including Magnet Room must be in accordance with local and national codes. 2. Consult local/national code for interconnects separation requirements (i.e. signal, power, water, air, etc.). 3. Must protect fiber optic interconnects, water lines, hoses and tubing from physical damage including liquids (i.e. condensation, coolants, etc.) 4. The majority of MR system cables used are pre-terminated to simplify interconnection but require routing to accommodate dimensions of the connectors. <ol style="list-style-type: none"> a. Raceway or conduit for routing interconnects must be sized to allow for the dimension of the connectors and the possibility of additional cables being added as the system is upgraded in the future. b. Raceway or conduit always to be sized to allow the cable to pass through with all other cables already installed. 5. Interconnect routing design must consider the MR system interconnect cables are FT4 or equivalent rated, not plenum rated. 6. If the area under the access floor is used for an air plenum then the cables may have to be in raceway depending on local and national codes. 7. MR system interconnects must be accessible for equipment servicing including troubleshooting and future enhancements or upgrades. 	
Magnet Room	<ol style="list-style-type: none"> 1. Metal access floor tiles are NOT allowed to be used anywhere in the Magnet Room, refer to requirements in Chapter 8, Magnet Room Floors. 2. Only non-magnetic metal material can be used when routing cables in the Magnet Room. 3. Electrically conductive materials and method(s) (i.e. raceway, access flooring) utilized for interconnects routing must comply with Chapter 8, RF Shielded Room Requirements to minimize the possibilities of electrical discharge which can cause RF broadband noise. 4. Site constructed or purpose built interconnect raceways must meet all construction and material requirements contained in this table to avoid the potential of becoming an RF broadband noise source. 5. Floor ducts/raceways used in the Magnet Room must meet the requirements in Chapter 8, RF Shielded Room Requirements and Chapter 8, Magnet Room Floors. 6. Cable routing methods must not interfere with an unobstructed path from the Patient Table to the area directly behind the Magnet Enclosure Rear Pedestal for MR personnel usage. 	<ul style="list-style-type: none"> • Conduit should not be used for running the main GE MR system cables in the Magnet Room due to the number and size of conduits needed. • Surface-mounted raceways are not recommended for routing cables and other interconnects within the Magnet Room due to the trip hazard of the raceway.

7 Flooring

Flooring consists of all materials above the structural floor support including subflooring and equipment support/mounting. Refer to [Table 3-7](#) for requirements and recommendations.

Table 3-7: MR System Flooring Requirements/Recommendations

Area	Requirements	Recommendations
Entire MR System	<ul style="list-style-type: none"> • Flooring materials must support the MR system equipment weight, refer to Floor Loading and Weights. • Floors must support the equipment and any transport device needed to move the equipment. • Flooring throughout the system including Magnet Room must be in accordance with local and national codes. • Floor design must consider the MR system interconnect cables are FT4 or equivalent rated, not plenum rated. 	Access flooring is not recommended because System Cabinet weight is about 1.2t. Floor with duct or pit is recommended.
Magnet Room	Refer to Chapter 8, Magnet Room Floors	

8 System Cooling Equipment Siting Considerations

8.1 System Cooling Equipment Configurations

The system requires water cooling for the BRM Gradient Coil located in the Magnet bore, the LCC Magnet Shield/Cryo Cooler Compressor Cabinet, and the water cooled System Cabinet. The following system cooling equipment is available with the MR system:

Table 3-8: System Cooling Equipment Configurations

	No equipment Room Note 1	Equipment Room Note 1
Cooling for System Cabinet	Liquid to Liquid Type Note 2	Liquid to Air Type Note 3
Cooling for BRM	MRCC Note 4	Indoor Type Note 5
Cooling for Shield/Cryo Cooler	Outdoor Air Cooled Note 6	Indoor air Cooled or Indoor Water Cooled Note 7
<p>Note 1: 'No equipment room' does not have space for the full MR system. Noisy Chiller and Compressor needs to be placed at outdoor. 'Equipment room' has space for the full MR system including noisy Chiller and Compressor.</p> <p>Note 2: Water Cooling Unit contains water cooled heat exchanger. It requires cooled water which comes from MRCC. Closed loop water with system cabinet is cooled through the heat exchanger and supplied by pump.</p> <p>Note 3: Water Cooling Unit contains Radiator and fans. It does not require cooled water. However, it blow hot air in the equipment room. Closed loop water with system cabinet is cooled through the radiator and supplied by pump.</p> <p>Note 4: MRCC supplies cooled water for both BRM and Water cooling unit parallelly. MRCC power is not provided from PDU in system cabinet.</p> <p>Note 5: Indoor type chiller for BRM is closed loop with BRM. It is supplied power from PDU in system cabinet.</p> <p>Note 6: Outdoor Air cooled compressor is closed loop with cold head.</p> <p>Note 7: Indoor cooled compressor is closed loop with cold head. If air cooled compressor is selected, it supplies hot air in the room.</p>		

NOTE: Gradient Coil water cooling must be supplied by cooling equipment supplied with the MR system to prevent contamination/damage to the coil and for proper image quality.

NOTE: Consult local/national code for interconnects separation requirements (i.e. signal, power, water, etc.).

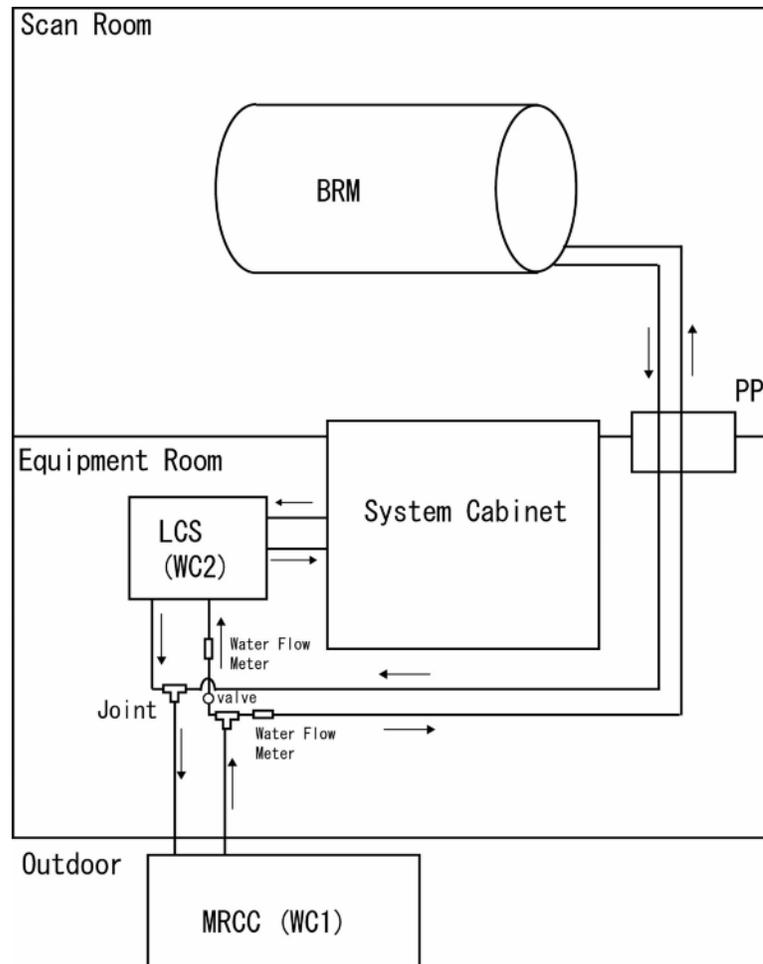
NOTE: Customer provided temporary backup water cooling is recommended for the Shield/Cryo Cooler Compressor Cabinet. Refer to [Chapter 5, Shield/Cryo Cooler Temporary Backup Water Cooling](#).

8.2 Water Chiller Siting Considerations for Type A Configuration

The MRCC(WC1) siting consideration is explained in [MRCC Siting Consideration](#). MRCC (WC1) provides water for Water Chiller - LCS (WC2) and BRM.

The Water Chiller (WC2) is an indoor dedicated, closed loop, chilled water is provided for the System Cabinet. Cooled Water is provided by MRCC(MR1). The system consists of a water-to-water Water Chiller (WC2), two flexible vinyl hoses, and de-ionized water.

Illustration 3-9: Type A Configuration



8.2.1 Water Chiller and MR System Interconnects

The two flexible hoses (supply and return) are to be routed from the MRCC (WC1). Each hoses are separated into two hoses by T-Shape Joint. One hose set (supply and return lines) is connected to Water Chiller for System Cabinet(WC2). The other hose set (supply and return lines) is routed through waveguides in the Penetration Panel, through the Rear Pedestal (MG3), and connect to the rear of the Gradient Coil with supplied adjustable compression clamps. The Water Chiller will be powered from the PDU via a supplied power cord.

The two flexible hoses (supply and return) are to be connected from the Water Chiller (WC2) to System Cabinet. The other flexible hoses (supply and return) are to be connected from the

MRCC(WC1) to System Cabinet. The Water Chiller will be powered from the PDU via a supplied power cord.

8.2.2 Water Chiller and MR System Separation Limitations

The MRCC(WC1) siting consideration is explained in [MRCC Siting Consideration](#).

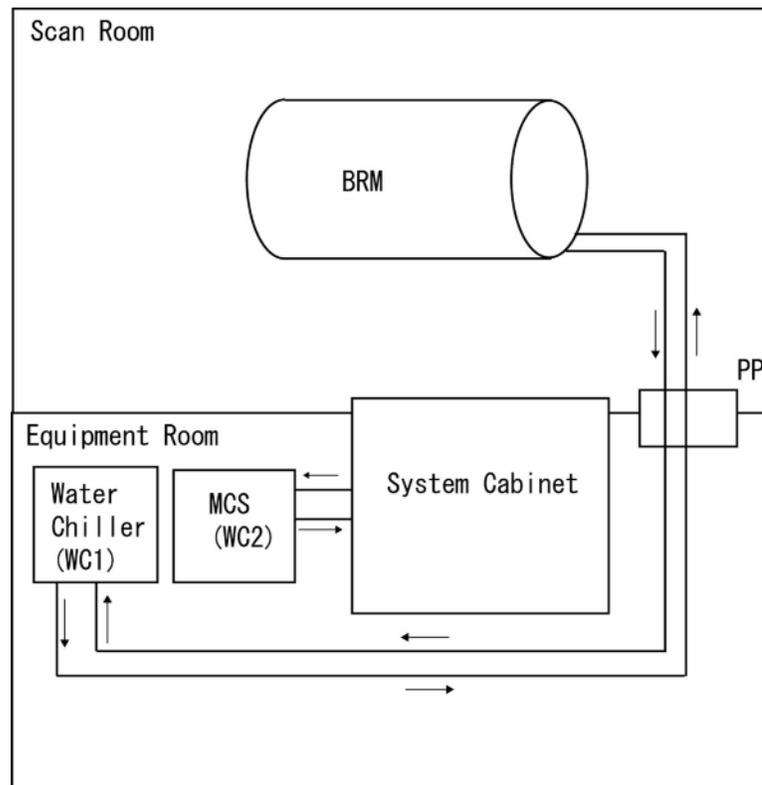
The Water Chiller (WC2) for System Cabinet must be located at the same level of System Cabinet.

8.3 Water Chiller Siting Considerations for Type B Configuration

The Water Chiller (WC1) is an indoor dedicated, closed loop, chilled water is provided for the Gradient Coil. The system consists of a water-to-air Water Chiller (WC1), two flexible vinyl hoses, and de-ionized water and anti-freeze (provided with the coil).

The Water Chiller (WC2) is an indoor dedicated, closed loop, chilled water is provided for the System Cabinet. The system consists of a water-to-air Water Chiller (WC2), two flexible vinyl hoses, and de-ionized water.

Illustration 3-10: Type B Configuration



8.3.1 Water Chiller and MR System Interconnects

The two flexible hoses (supply and return) are to be routed from the Water Chiller (WC1) through waveguides in the Penetration Panel (PP1), through the Rear Pedestal (MG3), and connect to the rear of the Gradient Coil with supplied adjustable compression clamps. The Water Chiller will be powered from the PDU via a supplied power cord.

The two flexible hoses (supply and return) are to be connected from the Water Chiller (WC2) to System Cabinet. The Water Chiller will be powered from the PDU via a supplied power cord.

8.3.2 Water Chiller and MR System Separation Limitations

The Water Chiller (WC1) for Gradient Coil Cooling must not be located below the Magnet Room floor level. The Water Chiller reservoir tank has a low pressure vent plug which relieves pressure from thermal expansion of water and activates when tank pressure reaches 3-5 psi (0.2-0.3 bar). The vent plug could allow fluid to leak if located below the MR system level. The reservoir tank

vented plug can not be replaced with a non-vented type, damage to the tank may occur. The Water Chiller may be located one floor level above the MR system.

The Water Chiller (WC2) for System Cabinet must be located at the same level of System Cabinet.

8.4 MRCC Siting Considerations

8.4.1 MRCC Interconnects/Separation Limitations

Location of the MRCC must meet the following limitations for the water lines:

- Outdoor water line (pipe) must be thermal insulated.
- Maximum vertical separation is not to exceed 98 ft (30 m) with the MRCC above the MR system or 9.8 ft (3.0 m) with the MRCC below the MR system.
- MRCC and the Remote Control Panel (RCP) must not be separated by a distance greater than 100 ft (30.5 m) total interconnect length.

The MRCC is powered from customer supplied power. Use GE MDP M3085TM option for MRCC and Outdoor Compressor.

8.4.2 MRCC Access & Air Considerations

Ensure there is easy access to the top cover of the unit. The air inlet and outlet are located on the unit front and rear respectively. Restricting airflow into or out of the MRCC will impair performance. The minimum clearances shown in [MR Common Chiller \(MRCC\)](#) are required on each side and top to ensure adequate airflow.

An MRCC unit installed in a high airflow area may be affected by the seasonal winds. In such environments it is recommended to install wind breaks for the MRCC.

8.4.3 MRCC Outdoor Installation Mounting

The MRCC must be located on a strong, level surface, see [MR Common Chiller \(MRCC\)](#) for concrete pad requirements for one MRCC unit. A chiller mounted on a slab on grade or rooftop will have the casters removed and be bolted down using the six middle holes shown in MRCC Outdoor Mounting illustration in [MR Common Chiller \(MRCC\)](#) to rigidly mount the unit.

8.4.4 Responsibility For Installation Tasks For MRCC Equipment

The MRCC subsystem equipment installation requires specific tasks to be performed by the Customer Contractor, GE Service, and Service Provider (dependent on site location Service provider, refer to [Table 3-10](#)). [Table 3-9](#) lists the responsibility for the specific tasks. Refer to vendor manual for additional information concerning tasks.

Table 3-9: MRCC Equipment Installation Tasks Responsibility

MRCC Equipment Responsibility For Installation Tasks When Used For Shield/Cryo Cooler Compressor Prior To Magnet Delivery & When Magnet Is Delivered/Installed				
Task	Responsible To Perform Task			Pays For Task & Materials
	Customer	GE	Service Provider See Table Note	
Unload chiller from truck	X			Customer
Move chiller to MR Equipment Room or Outdoor concrete pad and mount in accordance with local and national codes.	X			Customer
Connect customer supplied power from MDP to chiller	X			Customer
Install water lines to chiller	X			Customer

MRCC Equipment Responsibility For Installation Tasks When Used For Shield/Cryo Cooler Compressor Prior To Magnet Delivery & When Magnet Is Delivered/Installed				
Task	Responsible To Perform Task			Pays For Task & Materials
	Customer	GE	Service Provider See Table Note	
Install Remote Control Panel in Equipment Room	X			Customer
Fill chiller with glycol	X			Provided with MRCC
Start chiller, verify no leaks found (GE or Service Provider may assist).	X			N/A
Perform final Inspection of chiller and verify proper operation.			X	Service Provider
Note				
* The Service Providers are listed in Table 3-10 .				

Table 3-10: MRCC Service Providers

Location	Service Provider Address	Telephone	Fax
USA, Canada, & Mexico	Ellis & Watts International Inc. 4400 Glen Willow Lake lane Batavia, Ohio 45103	1-888-744-3195 or 1-513-768-3195	1-513-752-4983
Europe & other Americas countries	Advanced Cooling Technologies, LLC 2478 Armstrong Street Livermore, California 94551 USA	1-925-997-72.63	1-925-875-0002
Asia and all other countries	Lu Gu St. Shi Jingshan Dist. Beijing P.R. China	86-10-68656161	86-10-68652453

9 Special Siting Considerations

9.1 System Cabinet Special Consideration

This section describes the special consideration of System Cabinet and Penetration Panel.

Refer to [System Cabinet](#) for dimensions of System Cabinet.

For RF Shield Consideration for System Cabinet and Penetration Panel, refer to [Chapter 8, RF Shield Consideration for System Cabinet and Penetration Panel](#).



NOTICE

Specification of Floor under System Cabinet:

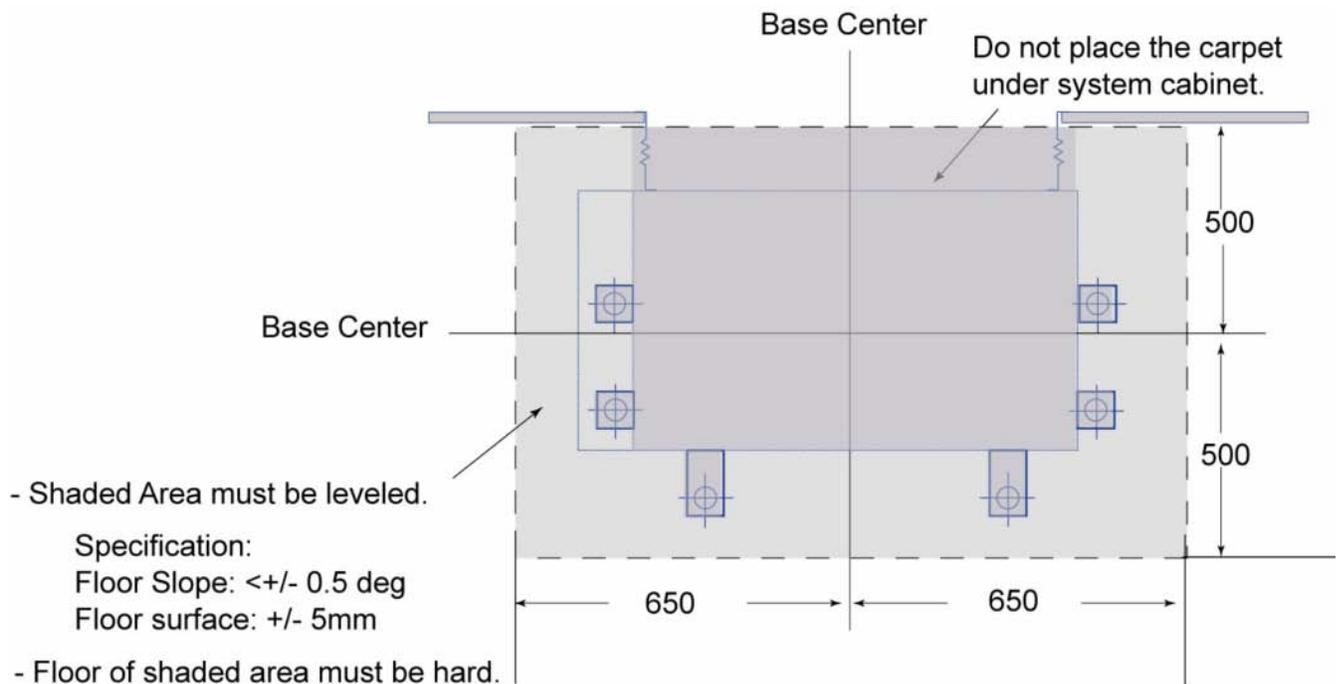
- Floor slope: < +/- 0.5 deg
- Floor surface: < +/-5mm in Cabinet installation area
- Installed Cabinet tilt: < +/- 0.5deg (Installed Cabinet level will be measured during mechanical installation)

NOTE: Use precision levels ('Block Type' or 'Square Frame Type') 150mm or longer to measure the level of floor.

Specification of precision levels: JIS B7510 (A Grade, Sensitivity 1~3) or equivalent.

Illustration 3-11 shows the area that must be leveled.

Illustration 3-11: Area to be leveled



[Illustration 3-12](#) shows anchor location of System Cabinet for non-seismic area or for seismic area (1st floor or lower).

NOTE: [Illustration 3-12](#) is a drawing for non-seismic area or for seismic area (1st floor or lower). For Seismic Area (2nd Floor or higher), refer to [Illustration 3-13](#)



NOTICE

M16 anchor bolts will be used to fix the system cabinet.

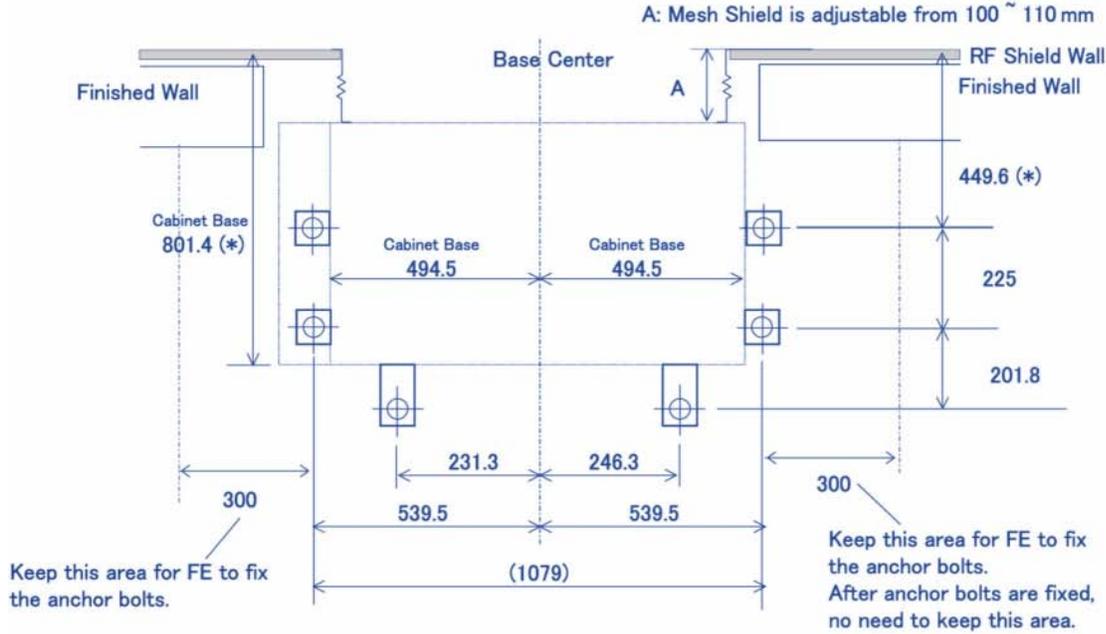
It is vendor's responsibility to prepare M16 bolts, female anchor inserts, and washers (6 pieces).

Anchor holes must be drilled and female anchor inserts are installed before system installation.

NOTE: It is recommended to extend Mesh Shield in between 100mm and 110mm. However, Mesh Shield can be extended to 180mm without any slack. In case there is any reason that the System Cabinet cannot be located closely enough to the RF shield, it is local site engineer's responsibility to extend Mesh Shield more than 110mm. Consider floor level under System Cabinet severely when extending the Mesh Shield more than 110mm.

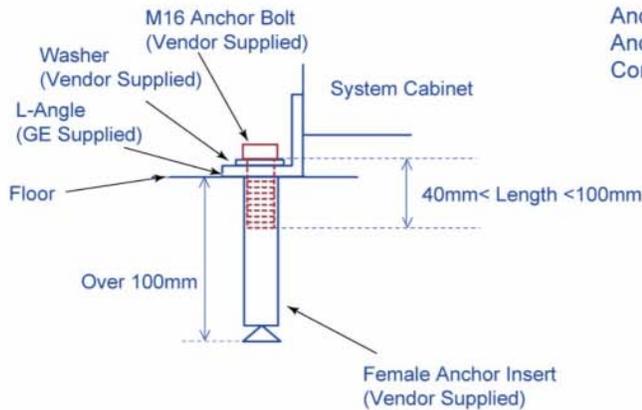
Illustration 3-12: System Cabinet Anchor Location (non-seismic area or for seismic area (1st floor or lower))

Anchor Location



Note: The value (*) is a recommended value.
 This value is flexible within specification of Mesh Shield (A).

Anchor Side View



Anchor Bolt : M16
 Anchor Length : 100mm over
 Concrete tensile strength : 17.6MPa(1760N/cm²) over

Important!!!
 M16 anchor bolts will be used to fix the system cabinet.
 It is vendor's responsibility to prepare M16 bolts, female anchor inserts, and washer (6 pieces).
 Anchor holes must be drilled and female anchor inserts are installed before System Installation.

[Illustration 3-13](#) shows anchor location of System Cabinet (For Seismic Area and 2nd Floor or higher).

NOTE: [Illustration 3-13](#) is a drawing for Seismic Area (2nd Floor or higher) . For non-seismic area or for seismic area (1st floor or lower), refer to [Illustration 3-12](#)



NOTICE

M16 anchor bolts will be used to fix the system cabinet.

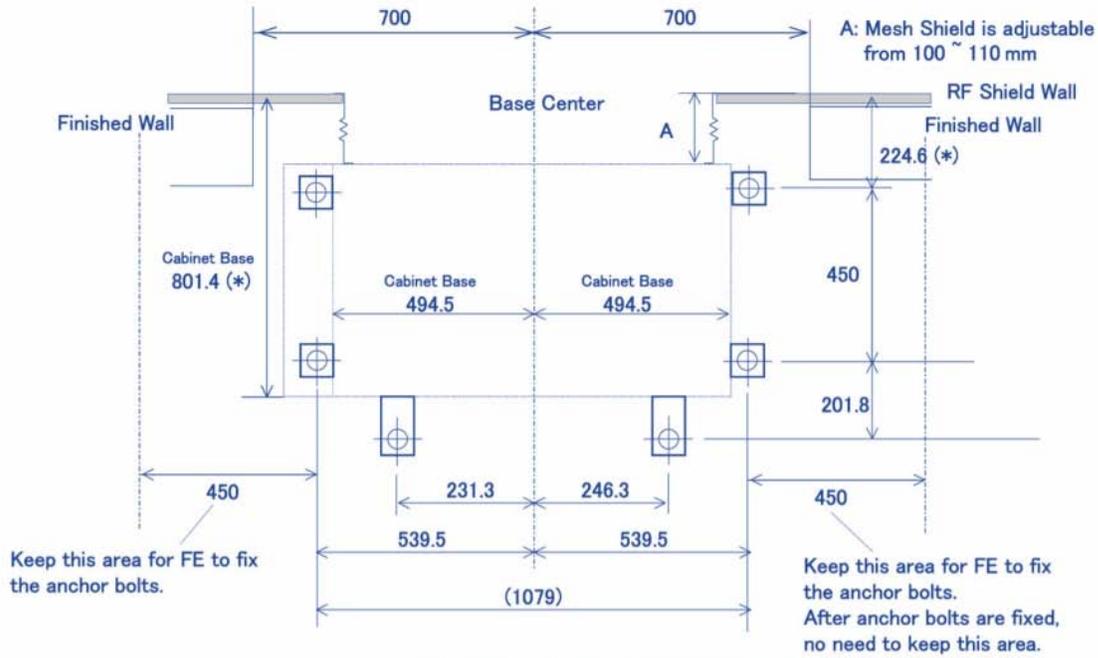
It is vendor's responsibility to prepare M16 bolts, female anchor inserts, and washers (6 pieces).

Anchor holes must be drilled and female anchor inserts are installed before system installation.

NOTE: It is recommended to extend Mesh Shield in between 100mm and 110mm. However, Mesh Shield can be extended to 180mm without any slack. In case there is any reason that the System Cabinet cannot be located closely enough to the RF shield, it is local site engineer's responsibility to extend Mesh Shield more than 110mm. Consider floor level under System Cabinet severely when extending the Mesh Shield more than 110mm.

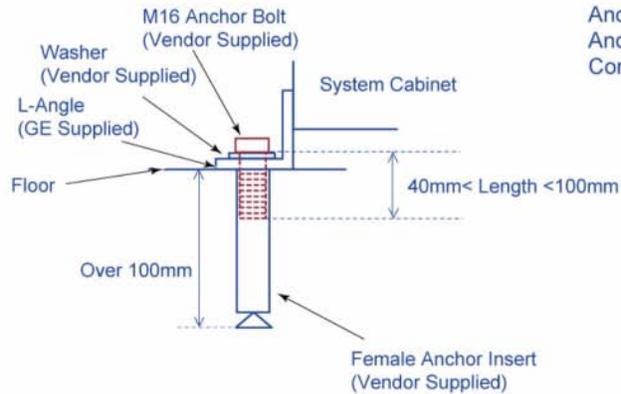
Illustration 3-13: System Cabinet Anchor Location (For Seismic Area and 2nd Floor or higher)

Anchor Location (For Seismic Area and 2nd Floor or higher)



Note: The value (*) is a recommended value.
This value is flexible within specification of Mesh Shield (A).

Anchor Side View



Anchor Bolt : M16
Anchor Length : 100mm over
Concrete tensile strength : 17.6MPa(1760N/cm²) over

Important!!:
M16 anchor bolts will be used to fix the system cabinet.
It is vendor's responsibility to prepare M16 bolts, female anchor inserts, and washer (6 pieces).
Anchor holes must be drilled and female anchor inserts are installed before System Installation.

Illustration 3-14 shows System Cabinet Water hose routing output.

Illustration 3-14: System Cabinet Hose Output

Hose Output

Hose route is selectable from pattern 1 or pattern 2 according to the site condition.

Pattern 1: Hose route is described in blue dotted line (---).

Pattern 2: Hose route is described in red dotted line (---).

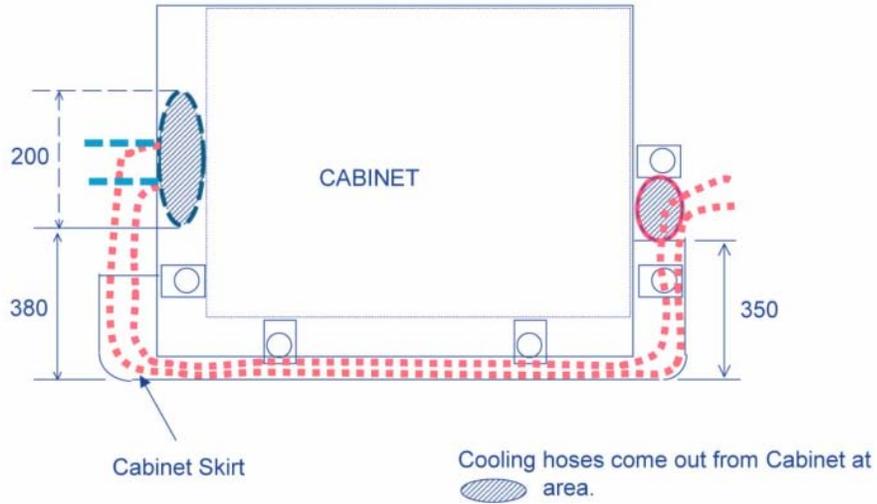


Illustration 3-15 shows minimum ceiling height of Equipment (or Operator) Room by considering the air flow of System Cabinet.

Illustration 3-15: Minimum Ceiling Height Specification of Equipment (or Operator) Room

Notice: Keep the gap between top of System Cabinet and Ceiling more than 400mm for air blow from System Cabinet.

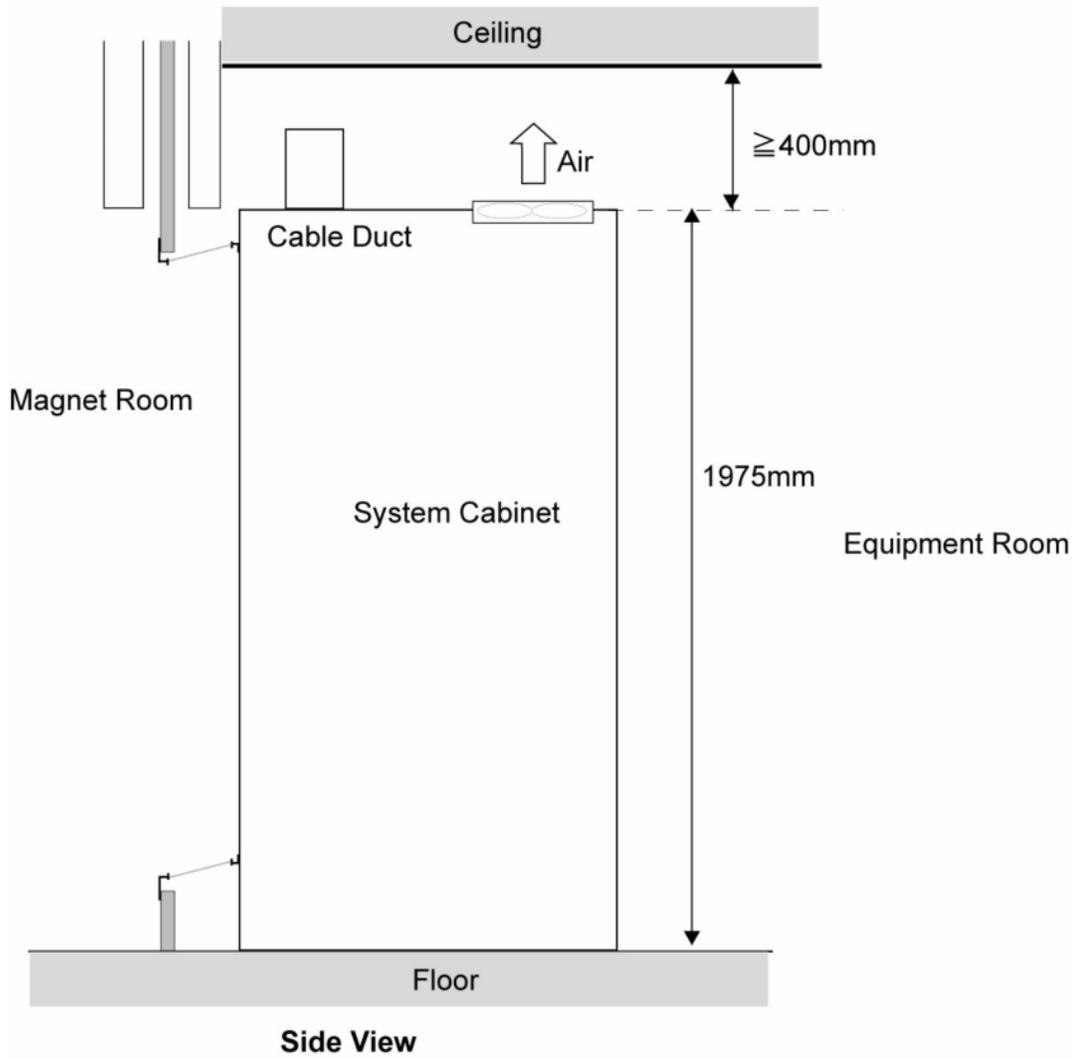
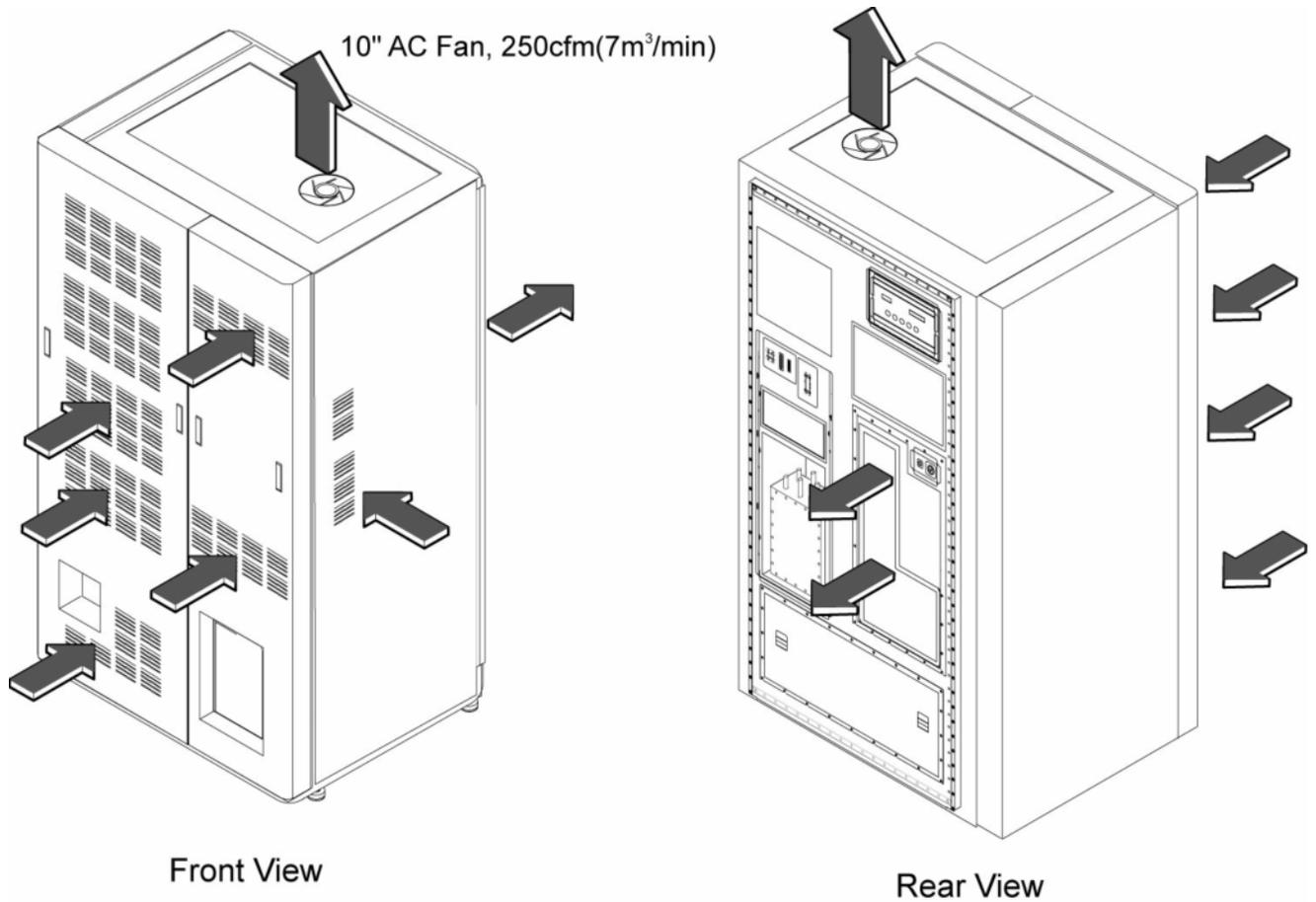


Illustration 3-16 show air flow of System Cabinet.

Illustration 3-16: System Cabinet Air Flow



9.2 Blower Box (MG6)



CAUTION

The Blower Box contains magnetic material which can be attracted to the magnet. The Blower Box must be securely mounted to the floor of the Magnet Room or a support shelf on the Magnet Room wall or ceiling with support provided under the box.



NOTICE

The Blower Box must be securely mounted per preceding Caution. Therefore the Blower Box must not be on a raised floor section within the Magnet Room. RF Shield integrity must be maintained for mounting the Blower Box within the Magnet Room, refer to [Chapter 8, RF Shield Integrity](#), [Chapter 8, Electrical Isolation](#), and [Chapter 8, Physical Characteristics](#).

NOTE: Blower Box mounting requires customer supplied hardware (ie. lag bolts, screws, etc.) appropriate for the surface on which the box will be mounted.

The Blower Box (MG6) provides cooling air for the RF/Gradient Body Coil and the Patient Comfort Module in the Magnet Enclosure. The Blower Box will be mounted within the RF Shielded Room and connects to the Gradient Coil and the Patient Comfort Module by 6.5 inch (165.1 mm) OD and 4.5 inch (114.3 mm) OD flexible vinyl air ducting.

The flexible vinyl air duct routes from the Blower Box through the Magnet Enclosure Rear Pedestal cable access and connects to the Patient Comfort Module in the Magnet Enclosure. Refer to Blower Box for box and mounting dimensions.

9.3 Pneumatic Patient Alert (PA1)

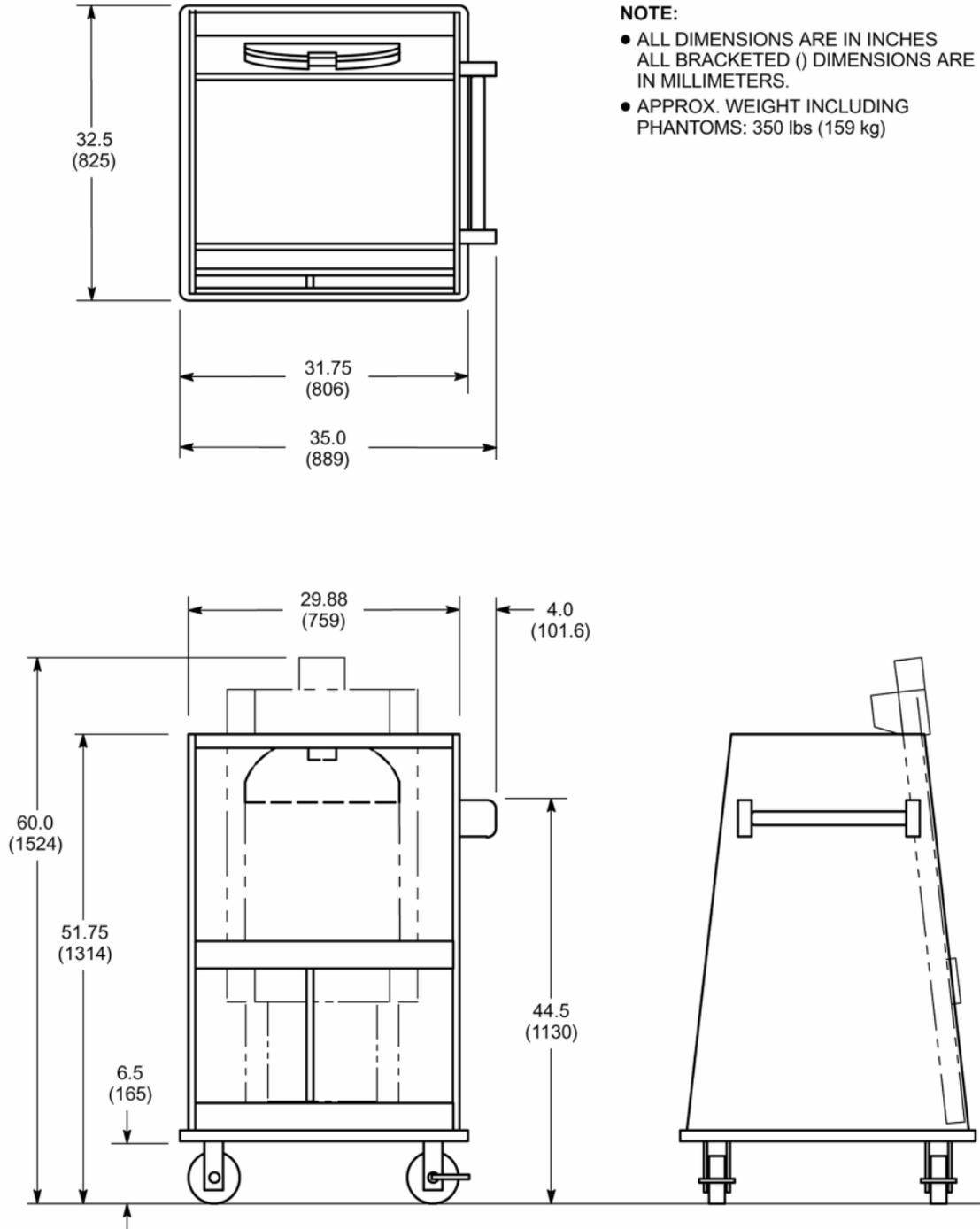
The Pneumatic Patient Alert system is a stand alone system that will allow the Patient to contact the Operator even when the intercom volume is turned down. The Control Box is to be located near the Operator Workspace. The Control Box audible and visual alarm will be activated by the patient squeeze bulb which is located on the Magnet Enclosure and connected by pneumatic tubing through the Penetration Panel to the Control Box. The Control Box should be mounted with consideration for ease of use by operator, remaining within sight of operator, and within 5 ft (1.5 m) of an electrical outlet. The Control Box can be powered from an outlet on the Operator Workspace. Refer to [Pneumatic Patient Alert](#) for Control Box mounting dimensions.

9.4 Customer Site Storage Requirements

The MR system has several system accessories such as system phantoms and surface coils. There are many optional surface coils available. Storage space for system accessories and supplies must be planned for and included in room layout drawings. Contact the GE Healthcare Project Manager of Installation for specific information.

SPT Phantom Set Shipping and Storage Cart is provided as part of the MR system. System Performance Test (SPT) provides the customer and GE Service with a means to quickly verify whether critical parameters affecting image quality are within specifications. The test uses a set a phantoms and a nesting plate for proper positioning of the phantoms on the Patient Table. The phantom set and nesting plate are provided on a cart which protects the pieces during shipment and storage at site. The cabinet is not magnetic therefore it can be stored inside the Magnet Room if so desired and moved to the Patient Table for ease of positioning the phantoms. See [Illustration 3-17](#) for cart dimensions information.

Illustration 3-17: SPT Phantom Set Shipping/Storage Cart



9.5 Oxygen Monitor Option

The optional Oxygen Monitor should be mounted near the Operator Workspace. The Oxygen Monitor alarm will be activated by the remote oxygen sensor located in the Magnet Room. All cellular telephones, even if not in use, should be kept at least 20 feet (6.1 meters) away from the Oxygen Monitor to prevent possible false trips of Oxygen Monitor alarms. See [Oxygen Monitor Option](#) illustrations.

9.6 Magnet Monitor

The Magnet Monitor performs the functions of a cryogen meter and Magnet pressure control with readout display capability on the unit and allows for remote monitoring during system warranty period or available as part of a GE Service contract. Refer to [System Monitoring and Support Connectivity](#) for broadband connectivity requirements.

The Magnet Monitor should be mounted approximately 60 in. (1524 mm) above the floor in the Equipment Room but outside the 10 gauss zone.

9.7 System Monitoring and Support Connectivity

One of the system monitoring and support connectivity configurations listed in Table 3-11 must be provided for system installation and serviceability purposes. The broadband network connection and telephone lines are to be provided and paid for by the customer.

Table 3-11: System Monitoring & Support Connectivity Requirements

Configuration	Connection Type	Use/Location
Broadband Network Connection & Telephone Line (Recommended)	Two Broadband Internet Accessible connections with individual Static IP addresses	One access located near the Operator Workspace (OW) in the Control Room (RJ45 wall mounted connection minimum speed of 10Mbps).
	See Note 1	One access located near the Magnet Monitor (MSM1) in the Equipment Room for remote monitoring of magnet pressure levels. This Broadband connection must not lose power when the MR system is shutdown (RJ45 wall mounted connection minimum speed of 10Mbps, with Internet access).
	One voice-grade telephone line (voice line)	Available for Service Personnel use, located in the Control Room
Multiple telephone lines (Alternate)	One voice-grade telephone line (voice line)	Available for Service Personnel use, located in the Control Room
	One line must be a dedicated direct-distance-dialing voice-grade line (data line)	Access located near the Operator Workspace (OW) in the Control Room. See Notes 2 & 3. (Standard RJ-11 connection is required)
	One line must be a dedicated direct-distance-dialing voice-grade line (data line)	Access located near the Magnet Monitor (MSM1) in the Equipment Room for remote monitoring. See Notes 2 & 3. (Standard RJ-11 connection is required)
<p>Notes</p> <ol style="list-style-type: none"> For Europe: An ISDN Connection with static IP address may be substituted for Broadband Internet Accessible connections. A dedicated direct-distance-dialing voice-grade telephone line can be shared for Operator Workspace (OW) and Magnet Monitor (MSM1) requirement through the use of a multiplexer box. The following multiplexer boxes are available for customer purchase. 46-328475P1 4 Line Phone Multiplexer box; 115 VAC input power 46-328475P3 4 Line Phone Multiplexer box; 220 VAC input power If the customer chooses not to purchase the multiplexer box then the customer must provide an additional line for each requirement as stated in this table. If a Multiplexer Box is used then the Magnet Monitor MUST be Channel 1 to allow for call out after a power outage. 		

9.8 Outdoor Unit for Type A Configuration

9.8.1 About Flexible Gas Line

For **Standard Configuration** (for **M3335SF**(OUTDOOR CHILLER AIR For 400V) or **M20032FE** (OUTDOOR CHILLER AIR For 200V)), following Flex Gas Lines will be provided.

- 5170492 FLEXIBLE GAS LINE, F-F, SUPPLY, 10M
- 5170263 FLEXIBLE GAS LINE, F-F, RETURN, 10M
- 5106664 Flexiline, Supply, Outdoor Compressor ,Sumoto 20M
- 5109503 Flexiline, Return, Outdoor, Sumitomo 20M

If required, order following **Extension Flexible Gas Line Option**. Refer to [Section 9.8.2](#) for Configurations.

- **M20162FE** Kit Indoor Extension Flexline 10M
 - 2255927 GAS LINE, FLEXIBLE (SUPPLY, F-M) 10M
 - 2255926 GAS LINE, FLEXIBLE (RETURN, F-M) 10M
- **M20062FY** Kit Outdoor Extension Flexline 10M
 - 5164987 GAS LINE, FLEXIBLE (SUPPLY, F-M) 10M
 - 5165070 GAS LINE, FLEXIBLE (RETURN, F-M) 10M

9.8.2 Outdoor Shield Cooler Compressor Wiring Diagram

Outdoor Shield Cooler Compressor Wiring Diagram is configured by five types according to the Flexible Gas Line length.

- Standard configuration (M3335SF) (Indoor 10M, Outdoor 20M) : [Illustration 3-18](#)
- Standard configuration (M3335SF) + Extension Indoor Flexline (10M) (M20162FE) (Indoor 20M, Outdoor 20M): [Illustration 3-19](#)
- Standard configuration (M3335SF) + Extension Outdoor Flexline(10M) (M20062FY) (Indoor 10M, Outdoor 30M): [Illustration 3-20](#)

Illustration 3-18: Standard configuration (M3335SF) (Indoor 10M, Outdoor 20M)

Standard configuration
 (Indoor 10M, Outdoor 20M)

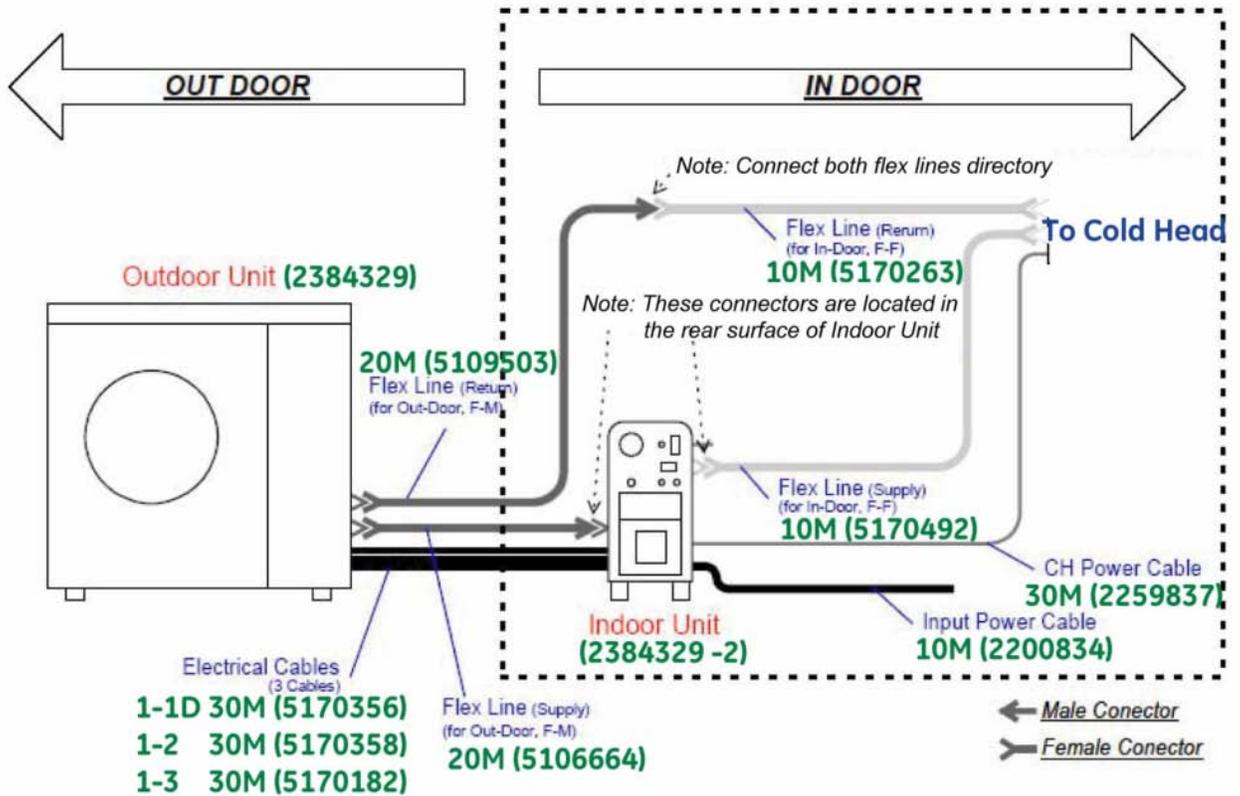


Illustration 3-19: Standard configuration (M3335SF) + Extension Indoor Flexline (10M)
 (M20162FE) (Indoor 20M, Outdoor 20M)

Standard configuration + Extension Indoor Flexline(10M)
 (Indoor 20M, Outdoor 20M)

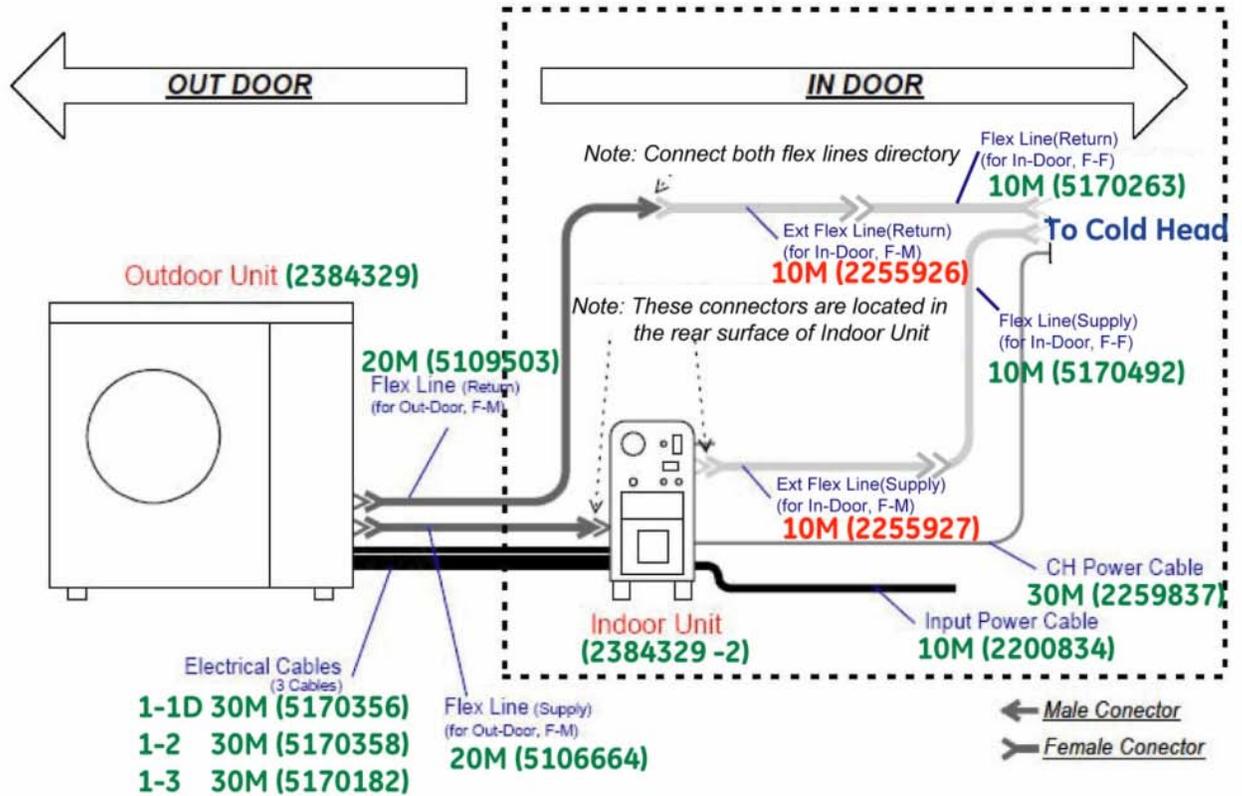
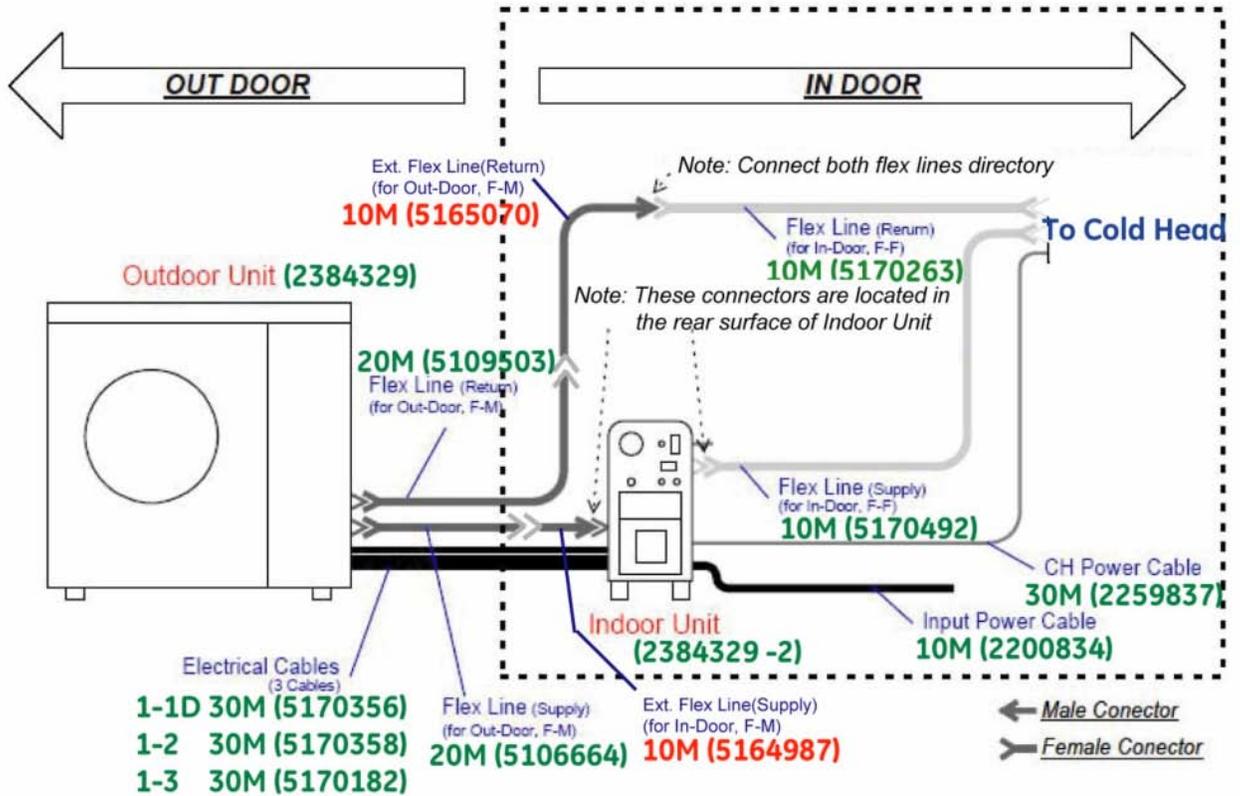


Illustration 3-20: Standard configuration (M3335SF) + Extension Outdoor Flexline(10M)
 (M20062FY) (Indoor 10M, Outdoor 30M)

Standard configuration + Extension Outdoor Flexline(10M)
 (Indoor 10M, Outdoor 30M)

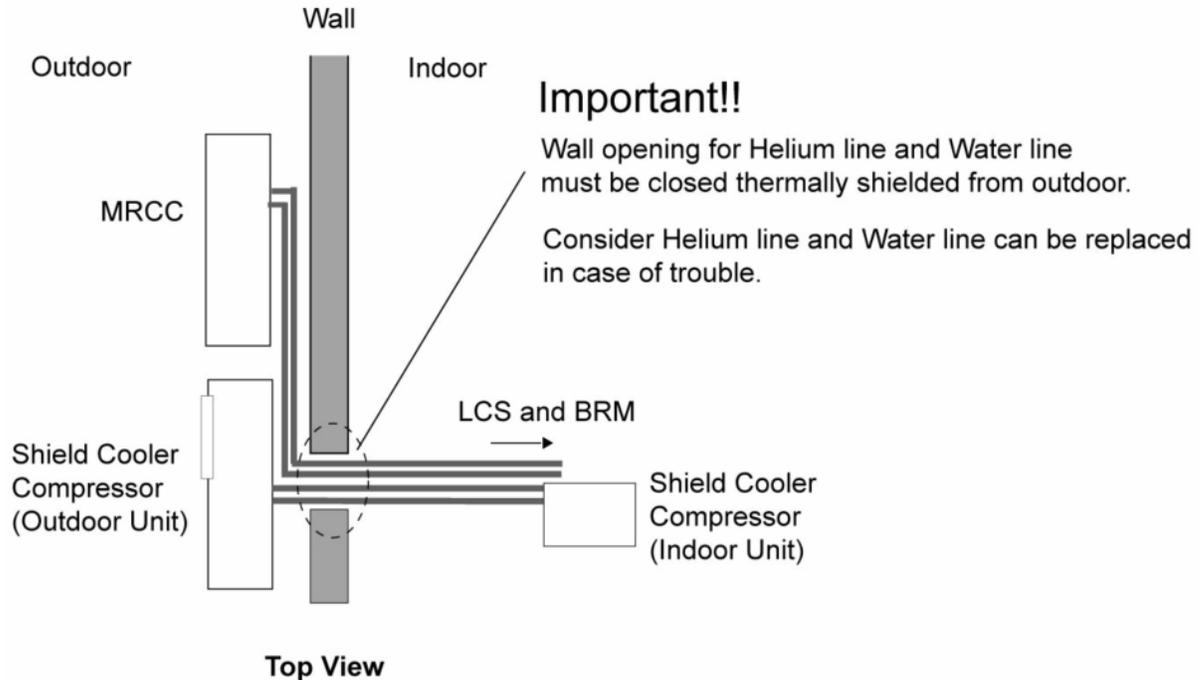


9.8.3 Notification Of Water and Helium Lines Through The Wall

Illustration 3-21 shows the Notification Of Water and Helium Lines Through The Wall.

Illustration 3-21: Notification Of Water and Helium Lines Through The Wall

For Type A configuration Only



9.8.4 Notification Of Installation Location



NOTICE

CONSIDER THE INSTALLATION LOCATION OF THE SUMITOMO OUTDOOR COMPRESSOR SO THAT FIELD ENGINEER CAN SAFELY PROCEED WITH INSTALLATION AND MAINTENANCE WORK.

ALSO, INSTALLATION LOCATION OF THE SUMITOMO OUTDOOR COMPRESSOR MUST BE IN COMPLIANCE WITH NATIONAL AND LOCAL LABOR SAFETY CODES.

9.8.5 Minimum Radius of Flexible Gas Line

- Minimum radius near connector of Unit : 300 mm
- Minimum radius other than condition above: 150 mm

9.8.6 Recommended Conduit for Outdoor Compressor Cable

9.8.6.1 For the 3 Conduits for the Power and Control Wiring

We recommend use of UV rated “Flexible Metal Conduit” or “Rigid Metal Conduit” for the installation of power and control wiring. However, “Flexible Metal Conduit” may not be acceptable in hazardous locations or locations where conduit will be easily damaged.

We recommend using as a minimum; 3/4” conduit for each of the one power wiring conduit (Replacement of the Cable1-1D; Min. 12AWG x4) and the two control wiring conduits (Replacement of the Cable1-2; Min.16AWG x9, Replacement of the Cable1-3; Min.16AWG x10).

Wiring shall be Type THHN or THWN or THHW for commercial type installations rated for 600V. The wiring can be color coded to match existing terminals as well as terminated with ring terminal connections.

Liquid-tight or rigid conduit connections will need to be installed on the Outdoor Unit housing and the Indoor Unit.

Make sure that the connection between the conduit and the Outdoor Unit housing is water tight.

9.8.6.2 For the Conduit for the Input Power Wiring

We recommend use of UV rated “Flexible Metal Conduit” or “Rigid Metal Conduit” for the installation of power and control wiring. However, “Flexible Metal Conduit” may not be acceptable in hazardous locations or locations where conduit will be easily damaged.

We recommend using as a minimum; 1/2” conduit. (Min. 12AWG x4)

Wiring shall be Type THHN or THWN or THHW for commercial type installations rated for 600V. The wiring can be color coded to match existing terminals as well as terminated with ring terminal connections.

Liquid-tight or rigid conduit connections will need to be installed on the Indoor Unit housing and the Disconnect Switch housing.

Make sure that the connection between the conduit and the Disconnect Switch housing is water tight.

9.9 TYPE C Chiller Configuration for Europe

9.9.1 CHILLER REQUIREMENTS FOR Type C CONFIGURATION (Europe Only)

9.9.1.1 SCOPE

This section describes the purchase specification for Signa HDe chiller for Type C configuration (Europe Only). The purpose of the single chiller is to provide cooling water for an MR system’s cabinet, gradient coil or coldhead compressor. The chiller can be used either indoors or outdoors.

NOTE: Contact your local GE Healthcare Project Manager about local supplied chiller.

9.9.1.2 APPLICABLE DOCUMENTS

9.9.1.2.1 GOVERNMENT REGULATIONS

Table 3-12: GOVERNMENT REGULATIONS

IEC 1000-4-2:2001	Electro-Static Discharge
IEC 1000-4-3:2002	Radiated Electromagnetic Fields Requirements
IEC 1000-4-4:1995	Electrical Fast Transient/Burst Requirements, Addendum 2001
IEC 1000-4-5:2001	Per EN 60601-1-2:1995 Surge Immunity Requirements
IEC 1000-4-6:2001	RF Conducted Immunity
IEC 1000-4-8:2001	Power Frequency Magnetic Field Immunity
IEC 1000-4-11:2001	AC Voltage/Phase loss

9.9.1.2.2 GE MEDICAL SYSTEMS AND SUPPLIER DOCUMENTS

9.9.1.2.2.1 COMPONENT DRAWINGS

None

9.9.1.2.2.2 INDUSTRY AND INTERNAL STANDARDS

ANSI/ISO 14,000 Standards

9.9.1.3 DEFINITION

This water chiller is a device used to circulate chilled water through system cabinet, gradient coil (BRM) or coldhead compressor with the purpose of removing heat generated during operation. It consists of a refrigeration unit, coolant reservoir and pump contained within an enclosure that allows the unit to be operated indoors or outdoors. The chiller will maintain the temperature of a propylene glycol/water (PGW) mixture(35% - 50%) or a de-ionized water with biocide and inhibitor at an adjustable setpoint which will be preset to 20°C ±1°C. If a de-ionized water is used, confirm that a coolant water should not freeze in operating condition.

9.9.1.4 INTERFACE REQUIREMENTS

9.9.1.4.1 INPUTS

9.9.1.4.1.1 ELECTRICAL

The chiller shall receive power via a four wire delta configuration hardwired into the GE main disconnect panel. It shall require no more than **9.6 kVA** (maximum continuous power) and **11.5 kVA** (peak power). The power cable shall be customer-supplied.

The chiller shall be able to accept three phase input power 380/400/415 VAC 50 Hz or 460/480 VAC 60 Hz. It must meet all requirements with the following voltage and frequency variations:

- Voltage: $\pm 10\%$ daily variation; $\pm 14\%$ up to 200 msec.
- Frequency: ± 3 Hz
- The chiller should list on its rating plate a maximum breaker rating of **25** amps.

POWER SWITCH

Power switches with lockout/tagout capabilities (on the unit as per OSHA regulations) shall be provided for servicing the unit. The main power switch for the unit shall be labeled as such.

The chiller shall also have an automatic restart function that allows the chiller to restart when power is restored to the facility after a power outage without any operator actions required. The starting sequence for the chiller components shall be staggered so that the starting sequence does not cause the maximum breaker rating from [Section 9.9.1.4.1.1](#) to be exceeded.

9.9.1.4.1.2 MECHANICAL

COOLANT SUPPLY AND RETURN CONNECTION

Coolant supply and return connection for the chiller shall be a $\frac{3}{4}$ inch corrosion-resistant, metallic, double-shutoff type quick disconnect with a hose barb for $\frac{3}{4}$ inch I.D. hose and hose clamp. The quick disconnect, hose barb and hose clamp shall be included with the chiller. See Appendix A—System Interconnect Diagram. Cooling air shall be available for intake by the chiller with the temperature range given in [Section 9.9.1.6.4](#).

9.9.1.4.2 REMOTE CONTROL PANEL

The chiller shall be provided with a remote control panel that allows the user to control the chiller whether it is located indoors or outdoors. The remote control panel shall allow the user to turn the chiller on or off as well as observe chiller temperature, temperature setpoint and alarm conditions.

9.9.1.4.3 PROTECTION DEVICES

9.9.1.4.3.1 LEVEL SWITCH

A first level switch shall generate an alarm when fluid level is low that the chiller needs to be refilled. A second level switch shall be provided with the chiller which will shut down the pump when a major loss of coolant occurs. A major loss of coolant is defined by the amount of coolant loss, will no longer allow the chiller to continue the operation per purchase spec.

9.9.1.5 PERFORMANCE CHARACTERISTICS

9.9.1.5.1 COOLING

The chiller shall provide liquid coolant at a temperature within $\pm 1^\circ\text{C}$ of the setpoint temperature, as reported on the front panel. The temperature shall be set to 20°C in the factory and must be field adjustable with a range from 15°C to 25°C . The chiller shall be designed such that it maintains the setpoint temperature under all specified operating conditions.

Cooling capacity of the unit shall be at least 15 kW (51,182 BTU/hr) for 50 or 60 Hz operation at the noted setpoint temperature within the environmental conditions specified in [Section 9.9.1.6.4](#).

The coolant water temperature shall be kept $20 \pm 1^\circ\text{C}$ under MR system load condition as below.

[MR System Load Condition]

The heat load of Signa HDe cabinet and BRM is a load from 0kW to Max. 5kW with intermittent time interval. The heat load of coldhead Compressor is a continuous load 7kW. Total heat load is a load from 7kW to Max. 12kW with intermittent time interval.

9.9.1.5.2 COOLANT SUPPLY SPECIFICATION (PRESSURE AND FLOW RATE)

Minimum flow rate required is 30 liters/minute (7.9 gallons/minute) at between 239 kPa (20 psig) to 455 kPa (66 psig) and no greater than 455 kPa (66 psig) , measured at the outlet of the chiller, under 50 or 60 Hz operation. A pressure relief valve shall be used to prevent the output of the chiller from exceeding 618 kPa (75 PSIG). This assumes a total line length of 61m (200 ft) of ¾ inch I.D. copper pipe (provided by customer) and an additional 61m (200 ft) of ¾ inch I.D. hose (provided with the chiller). Total line length includes both supply and return lines.

9.9.1.6 PHYSICAL CHARACTERISTICS

9.9.1.6.1 SIZE

The chiller shall require no more than 1.5 m2 (16 ft2) for equipment and 2.6 m2 (27 ft2) of floor space including air flow requirements and service access requirements. The dimensions of the chiller must allow for the unit to be moved through a doorway 36 inches (0.9 m) wide by 80 inches (2 m) high.

9.9.1.6.2 MASS

The mass of the chiller shall not exceed 362 kg (800 lbs) with filled reservoir. The nominal center of gravity shall be provided for operating and shipping conditions (filled or unfilled) and shall be in the lower half of the unit for ease of movement.

9.9.1.6.3 MOBILITY

The chiller shall be provided with the ability to roll, thus allowing relocation along any flat or slightly inclined surface (5° incline). Heavy-duty swiveling casters shall be installed. Casters shall be lockable once the unit is in position. Per GE Healthcare Service EHS requirements, the unit shall not require more than 35 lbs (156 N) of force to move.

9.9.1.6.4 ENVIRONMENTAL CONDITIONS

9.9.1.6.4.1 NON-OPERATING

The chiller shall function and meet all performance requirements after exposure to any combination of the following environments.

Table 3-13: ENVIRONMENTAL CONDITIONS (NON-OPERATING)

Ambient Temperature	-34C (-29.2F) to +55C (131F)
Humidity	Up to 100% RH
Shock and vibration	See Section 9.9.1.6.5.3 below
Altitude	120m (400 ft) below to 3352m (11,000 ft) above sea level
Magnetic Field	30 Gauss

9.9.1.6.4.2 OPERATING

The chiller shall meet all performance requirements during exposure to any combination of the following environments.

Table 3-14: ENVIRONMENTAL CONDITIONS (OPERATING)

Humidity	Up to 100% RH
Altitude	30 m (100 ft) below to 1524 m (5000 ft) above sea level
Elevation above MR	30 m (100 ft)
Elevation below MR	3 m (9.8 ft)
Magnetic Field	30 Gauss

Note 1: Maximum allowable temperatures may be reduced for high altitude operation by a factor of 6.4°C per 1000m.

9.9.1.6.5 DESIGN AND CONSTRUCTION

9.9.1.6.5.1 MATERIALS

TOXICITY

Toxic materials that represent a hazard to people and the environment should be avoided. If it is necessary to use any toxic material, consult with the Manager, Global EHS for recommendations on safe use of the material.

SHARP EDGES

Sharp projections and edges on parts and materials accessible to service personnel shall be minimized.

CORROSION

Metals shall be corrosion resistant type or suitably processed to resist corrosion. Some exceptions may apply if functionality of the device such as heat sink is impaired by coatings. The use of any protective coatings that may crack, chip or scale with normal use, aging or extremes of environment specified herein, shall be avoided.

9.9.1.6.5.2 ELECTROMAGNETIC COMPATIBILITY

The supplier shall assist GE Healthcare with system level test, failure analysis and correction with root cause attributable to the chiller, and certification. The unit shall produce no coherent or broad band spike noise RFI emissions in the 200 kHz band surrounding 127.728 MHz, 63.864 MHz, 42.576 MHz, 29.8032 MHz and 21.288 MHz as measured by the GE MR system. The supplier shall be responsible for obtaining and maintaining CE certification.

9.9.1.6.5.3 SHOCK AND VIBRATION

The chiller shall be compliant with the current revision of 46-316745, GE Healthcare document “Mechanical Environmental Test Guidelines”. All sections of the document with the exception of the “over the road mobile” requirements are applicable.

9.9.1.6.5.4 SEISMIC REQUIREMENTS

The chiller must allow for seismic mounting at the lower framework on the front and back of the unit. Seismic mounting shall comply with OSHPD regulations. The supplier will work with GE Healthcare to develop a seismic mounting kit, however this kit will not be required to ship with every chiller.

9.9.1.6.5.5 PRODUCT MARKINGS AND IDENTIFICATION

BAR CODE

Not applicable

ELECTRICAL

The enclosure shall be labeled with input voltage, input current and frequency in close proximity to the power connection.

PRODUCT CHANGES

Any and all changes initiated by the manufacturer which impact form, fit or function; or performance, maintenance, service, reliability or certification, either positively or negatively shall be preceded by a sixty day notice to GE Healthcare. See also 3.7.3.

COUNTRY OF ORIGIN LABEL

A label shall be applied listing the country of origin (for example, Made in China).

SHIP LOOSE ITEMS

The following items shall be shipped loose with the chiller:

Table 3-15: SHIP LOOSE ITEMS

1. QTY 4 - 3/4 inch (19.1 mm) hose barbs
2. QTY 8 - 3/4 inch (19.1 mm) hose clamps
3. QTY 2 - 3/4 inch quick disconnect fittings. Both male and female halves shall be included.
4. QTY 4 - 30.5 m (100 ft) lengths of 3/4 inch (19.1 mm) flexible rubber hose
5. QTY 2 - 1 meter section of 3/4 inch (12.7 mm) ID rubber hose with 1/2" to 3/4" hose adapter fitting to allow the 3/4 inch hose to be connected to the 1/2 inch fittings on the cold head compressor.
6. QTY 1 Remote control panel
7. QTY 1 Control cable from remote control panel to chiller
8. QTY -- Chiller volume (lines & reservoir) plus 12 gallons (45.4 liters) of propylene glycol/water (PGW) mixture (35% - 50%) or a de-ionized water with biocide and inhibitor
9. QTY 1 Funnel to aid in filling unit
10. QTY 6 Each of the following terminals: 1.0 mm ² (1.55X10 ⁻³ in ²), 1.5mm ² (2.33X10 ⁻³ in ²) and 6mm ² (9.3X10 ⁻³ in ²)
11. QTY 1 Roll of Teflon tape 20mX25mmX0.1mm
12. QTY 2 - 30.5 m (100 ft) lengths of 3/4 inch (19.1 mm) copper pipe
13. QTY 4 - 0.6 m (2 ft) lengths of 3/4 inch (19.1 mm) copper pipe
14. QTY 2 - T type manifold
15. QTY 4 - Valve between 1 and 13
16. QTY 4 - 1/2inch (12.7 mm) hose clamps
17. QTY 2 - 10 m (33 ft) lengths of 3/4 inch (12.7 mm) flexible rubber hose

VIBRATION ISOLATION

The supplier shall work with GE Healthcare to add vibration isolation if MR system-level testing shows that chiller vibration affects image quality.

REFRIGERATION PIPING LEAKAGE TESTS

The unit must maintain this vacuum for the test to pass. Following all chiller functional checks, all refrigerant piping connections shall be checked with a refrigerant leak test instrument. The highest leakage rate shall be recorded and this rate shall not exceed 14 gram/year.

DIELECTRIC WITHSTAND TEST

All electrical components which are rated for greater than 30V shall be tested for dielectric breakdown by applying a voltage (equal to 1000V plus two times the rated voltage of the component) between the component and ground for at least one minute. The leakage current shall not exceed 20 mA.

9.9.1.7 SAFETY/REGULATORY REQUIREMENTS

9.9.1.7.1 SAFETY REQUIREMENTS

9.9.1.7.1.1 NRTL

The chiller shall be certified by a National Recognized Testing Laboratory (NRTL) to comply with the applicable IEC standards to the device. Each unit shall bear a certification monogram of the NRTL. The common chiller shall be certified as being in compliance with the appropriate European EMC standards for the device and bear the CE monogram.

9.9.1.7.1.2 ACOUSTIC NOISE

The chiller shall not generate sound pressure levels (SPL) measured one meter in any direction from its external surfaces above 75 dBA under normal operating conditions. The SPL shall be measured as an "A-weighted" Leq averaged over a time period of at least 20 seconds.

9.9.1.7.2 SAFETY AND REGULATORY EVALUATIONS

9.9.1.7.2.1 HAZARD ANALYSIS

A hazard analysis, prepared by GE Healthcare, shall be jointly conducted by the device manufacturer and GE Healthcare.

9.9.1.7.2.2 SAFETY/REGULATORY DESIGN REVIEW

A Safety/Regulatory Review shall be jointly conducted by the device manufacturer and GE Healthcare.

9.9.1.7.2.3 REGULATORY LABELING

Labels describing regulatory approvals of IEC and CE must be attached to the chiller.

9.9.1.8 SUPPLIER QUALITY AND REGULATORY COMPLIANCE

9.9.1.8.1 SUPPLIER ROOT CAUSE/CORRECTIVE ACTION PROCESS

Suppliers shall provide failure analysis and repair data to GE Healthcare from their manufacturing and repair operations upon request from GE Healthcare.

9.9.1.8.2 PURCHASE MATERIAL QUALITY REQUIREMENT

The supplier shall conform to the GE Healthcare “Purchase Material Quality Requirement”, to be generated by GE Healthcare Sourcing.

9.9.1.9 SERVICE REQUIREMENTS

Supplier shall maintain all chiller at 24 hour and 365 days. If GE Healthcare gives customer call about chiller trouble, they call supplier to repair it.

9.9.1.9.1 ACCESS

Access cover(s) shall be provided for coolant fill. The coolant reservoir inlet height shall be less than 1524 mm (60 inches) for ease of fill. Cabinet design should support access from the front of the cabinet for installation, calibration and replacement/maintenance activities. All operational displays and indicators shall be viewable without the removal of covers. Potential pinch points or entrapment points shall be minimized.

9.9.1.9.2 PERIODIC MAINTENANCE

Supplier shall make a contract of full maintenances with customer. And Supplier shall provide sudden repair and periodic maintenance.

9.9.1.9.3 DOCUMENTATION AND FIELD SERVICE SUPPORT

9.9.1.9.3.1 OPERATOR DOCUMENTATION

Supplier shall provide operation manual of the chiller.

9.9.2 Gradient Water Heat Exchanger (GWHX)

9.9.2.1 POWER SPECIFICATION OF HEAT EXCHANGER

**NOTICE**

Heat exchanger power must be supplied from MDP. Do NOT connect the power cable to System Cabinet.

Regarding MDP, refer to [Main Disconnect Panel \(MDP\) Requirements For Type C \(Europe Only\)](#)

- Power Consumption : 0.75kW
- Voltage Requirements : 120VAC \pm 10% @ 50Hz \pm 3% or 60Hz \pm 3%
- Circuit Size : 12Amp (Maximum)
- Wire : 12 AWG(3.3mm²)

9.9.2.2 FRU for Heat Exchanger (2343325)

Table 3-16: FRU for Heat Exchanger (2343325)

Part Name	Part Number	FRU
Heat Exchanger	2343325	Yes
Quick Disconnect Kit	2341077-2	Yes
Glycol(50/50 mix)	2297672	Yes

9.9.2.3 Heat Output

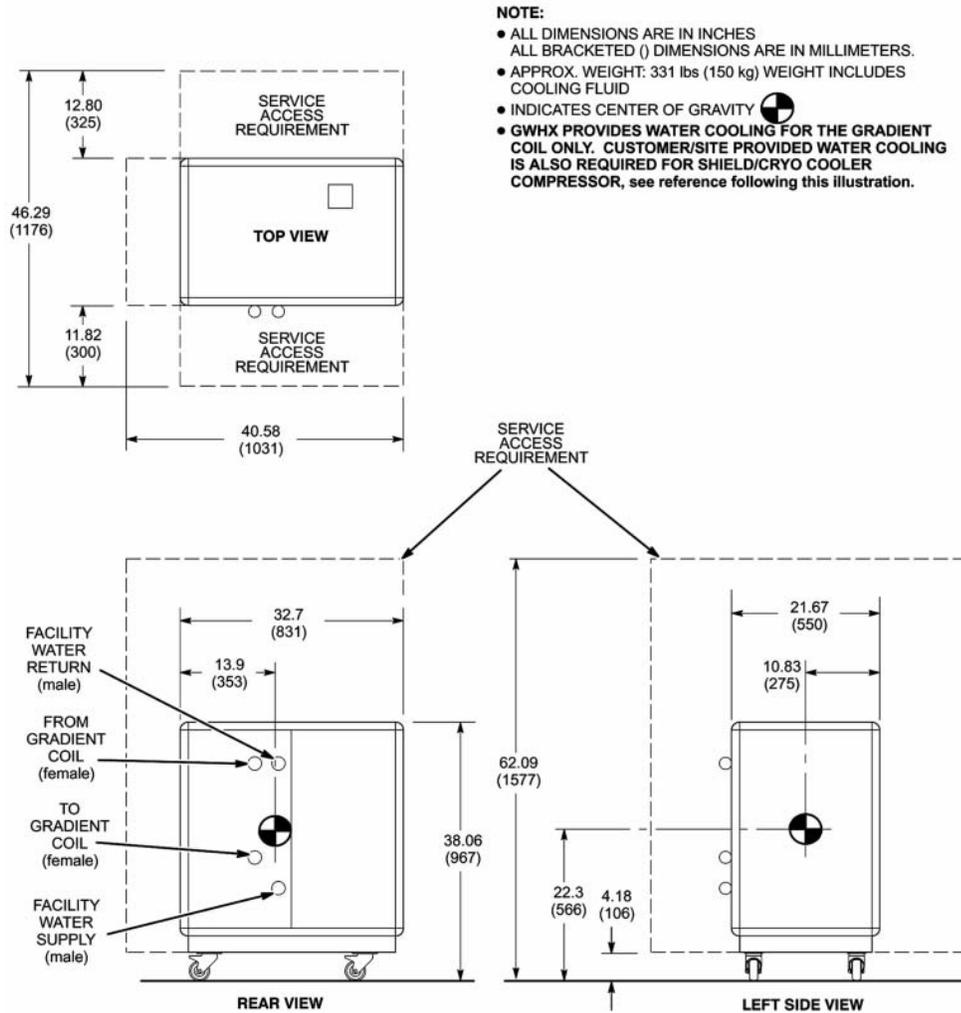
Water Cooled GWHX Heat Output is as follows.

- 1707 BTU/hr (500 Watt)

Consider the air cooling by this value and by referring to [Chapter 5, Air Cooling](#).

9.9.2.4 Component Dimensions

Illustration 3-22: Indoor Gradient Water Heat Exchanger (GWHX) for Gradient Coil Cooling Water



9.9.3 Main Disconnect Panel (MDP) Requirements For Type C (Europe Only)



NOTICE

Customer provided MDP MUST meet all MDP requirements.



WARNING

CUSTOMER SUPPLIED MAIN DISCONNECT PANEL DESIGN NEEDS TO HAVE CORRECTLY SIZED WIRES AND RATED COMPONENTS TO MEET THE MR SYSTEM POWER REQUIREMENTS.



WARNING

IF AN UNINTERRUPTIBLE POWER SUPPLY (UPS) WILL BE PROVIDING POWER TO THE ENTIRE MR SYSTEM THEN THERE IS A NEED TO MAKE SURE THE UPS OPERATION PARAMETERS ARE COMPATIBLE WITH THE SIGNA SYSTEM POWER AND REGULATION DEMANDS.

The customer supplied MDP must provide multi-point remote control capability which is shown in [Illustration 3-23](#).

The design of the MDP must incorporate an adjustable time delay auto restart control circuit for the Chiller for Type C, Heat Exchanger, the Shield/Cryo Cooler Compressor Cabinet, and the single phase transformer for Magnet Monitor equipment (Magnet Monitor, optional UPS for Magnet Monitor, modem and the optional Multiplexer Box). The PDU shall not be included in the auto restart control circuit. Operation of any remote Emergency Off pushbutton MUST disable all MDP power and control circuits. LED pilot lights shall indicate system power status.

All control shall be low voltage. Power components shall be selected to provide type 2 coordination between overcurrent devices and all contactors. The 120 VAC supply receptacles for remotely mounted Magnet Monitor UPS (option) and Mux Box (option) must be included along with properly protected control power transformer. The 120 VAC UPS output power shall be connected back into the MDP for distribution to the Magnet Monitor and Modem. Operation of the previously mentioned Emergency Power Off pushbuttons shall disconnect and isolate the Magnet Monitor UPS output circuits from the Magnet Monitor and modem as well as disable the auto restart function.

The customer supplied MDP must consist of the following:

- A three-pole Main Circuit breaker rated for the total current of all the sub-breakers circuits. The short-circuit current interrupting rating of the breaker is 25,000 Amperes minimum or higher interrupting rating sufficient to interrupt the facility available short circuit current at its installed location per NEC 2002 Article 110.9.
- A three-pole circuit breaker rated for the current of the PDU circuit. The short-circuit current interrupting rating of the breaker is 25,000 Amperes minimum or higher interrupting rating

sufficient to interrupt the facility available short circuit current at its installed location per NEC 2002 Article 110.9.

- A three-pole circuit breaker rated for the current of the Chiller circuit. The short-circuit current interrupting rating of the breaker is 25,000 Amperes to accommodate facility available short circuit current.
- A circuit to provide 120VAC single phase power to the Heat Exchanger. The short-circuit current interrupting rating of the breaker is 25,000 Amperes to accommodate available fault current. The MDP includes a single phase step down transformer for 120VAC loads such as Heat Exchanger.
- A three-pole circuit breaker rated for the current of the Shield/Cryo Cooler Compressor Cabinet circuit. The short-circuit current interrupting rating of the breaker is 25,000 Amperes to accommodate facility available short circuit current.
- A circuit to provide 120VAC single phase power to the Magnet Monitor, Modem, UPS for Magnet Monitor (optional), and Multiplexer Box (optional). The short-circuit current interrupting rating of the breaker is 25,000 Amperes to accommodate available fault current. The MDP includes a single phase step down transformer for 120VAC loads such as Magnet Monitor equipment (Magnet Monitor, optional UPS for Magnet Monitor, modem and the optional Multiplexer Box).
- The MDP Panel has receptacles inside the panel enclosure for connections of the UPS for Magnet Monitor input and output, Multiplexer Box, Magnet Monitor, and modem. The enclosure has provision for these cables to enter through the access panels in the bottom left side of the enclosure. Mounting of the panel must allow for 5-6 inch (127-152 mm) of free space to allow for cable bending and installation. Strain relief bushings are provided with the individual equipment for each of these cables, not provided with the MDP.

The MDP is to be located so the top of the upper circuit breaker handle when in the ON position does not exceed 79 inches (2000 mm) from the floor and visible to Power Distribution Unit (PD1), MRCC or its RCP, Shield/Cryo Cooler Compressor Cabinet, and the service personnel. The optional UPS for the Magnet Monitor may be located below the MDP if sufficient space is available or adjacent if sufficient space is not available.

NOTE: The customer supplied MDP circuits for the Chiller, the Shield/Cryo Cooler Compressor Cabinet, and the single phase transformer for Magnet Monitor equipment (Magnet Monitor, optional UPS for Magnet Monitor, modem and the optional Multiplexer Box) have auto restart upon return of normal power after a time delay of 3 to 30 seconds (field adjustable) to minimize cryogen consumption of the system. The MDP Emergency Off circuit turns off power to all branch circuits including the Magnet Monitor UPS option output and turns off the auto restart function.

NOTE: The PDU circuit must have low voltage release feature which disconnects power from the PDU upon the first loss of power. Power to the PDU is not restored automatically after a power interruption. Emergency Off operation disconnects power from all circuits including the PDU.

The circuit breakers or fuses ahead of the MDP must be capable of handling the magnetizing inrush currents of the Chiller for Type C, Heat Exchanger, Shield/Cryo Cooler Compressor, Magnet Monitor equipment, and transformer of the PDU module (PD1) in the System Cabinet (MR3). If fuses are used time delayed fuses are recommended.

Check local and national codes to determine if an interlock to the air-conditioning unit in the Equipment Room is required in the protective disconnect set-up.

The customer supplied MDP option must provide two Emergency Off buttons to be connected to the MDP to disable the power to all system equipment in emergency situations. The Emergency Off buttons are to be mounted near each exit in the Magnet Room and Equipment Room at a height specified by local/national codes and connected to the protective disconnect device in order to disable the power to all MR system equipment in emergency situations. The Emergency Off buttons are to be clearly labeled "Emergency Off" and visible to personnel. It is important the buttons are labeled "off" and not "stop" since there exists an "Emergency Stop" button in the Signa system which powers down only a portion of system equipment for patient safety.

NOTE: The emergency off circuit disconnects power to the PDU, Chiller, Shield/Cryo Cooler Compressor Cabinet, the single phase 120V transformer output and optional UPS (if purchased) for Magnet Monitor equipment. Power can be restored to the MDP outputs by pressing the MAIN POWER ON pushbutton on the MDP for the Chiller, Shield/Cryo Cooler Compressor Cabinet, Magnet Monitor equipment (Magnet Monitor, optional UPS for Magnet Monitor, modem and the optional Multiplexer Box). Power to the PDU is restored by pressing the PDU POWER ON pushbutton and also requires pressing the EMO Reset button on the PDU.

The MDP must be lockable to provide for single point power Lockout/Tagout requirements. The MDP provides for the disconnection of the facility power to the PDU, Chiller, and Shield/Cryo Cooler Compressor Cabinet. Individual branch circuits for the PDU, Magnet Monitor equipment, Chiller, and Shield/Cryo Cooler Compressor Cabinet must be lockable circuit breakers. Check local and national codes to determine if an interlock to the air-conditioning unit in the Computer/Equipment Room is required in the protective disconnect set-up.

The MDP must be listed and labeled by a Nationally Recognized Testing Lab (NRTL) such as Underwriters Laboratory (UL) in accordance with 2002 National Electric Code (NEC) Article 110.2. A customer designed and manufactured MDP labeling must bear the appropriate markings per local/national regulations.

NOTE: The maximum conductor the Customer supplied MDP shall accept is #3/0 AWG (83 mm²). For feeders larger than 3/0 AWG (83 mm²) the wires must be reduced (ie. splice, junction box, etc.) to 3/0 AWG (83 mm²) within 10 feet (3 meters) of MDP. It is important to note the maximum cable wire from the MDP to the PDU must not be larger than 2/0 AWG (70 mm²).

Illustration 3-23: Protective Disconnect Setup For Type C Configuration

NOTE: RUNS 296 AND 297, & POWER CORDS FOR SHIELD/CRYO COOLER COMPRESSOR CABINET, HEAT EXCHANGER, AND MAGNET MONITOR EQUIPMENT (MAGNET MONITOR, UPS INPUT & OUTPUT, MODEM, OPTIONAL MULTIPLEXER) ARE GE SUPPLIED CABLES. **ALL OTHER WIRING IS CUSTOMER SUPPLIED.**

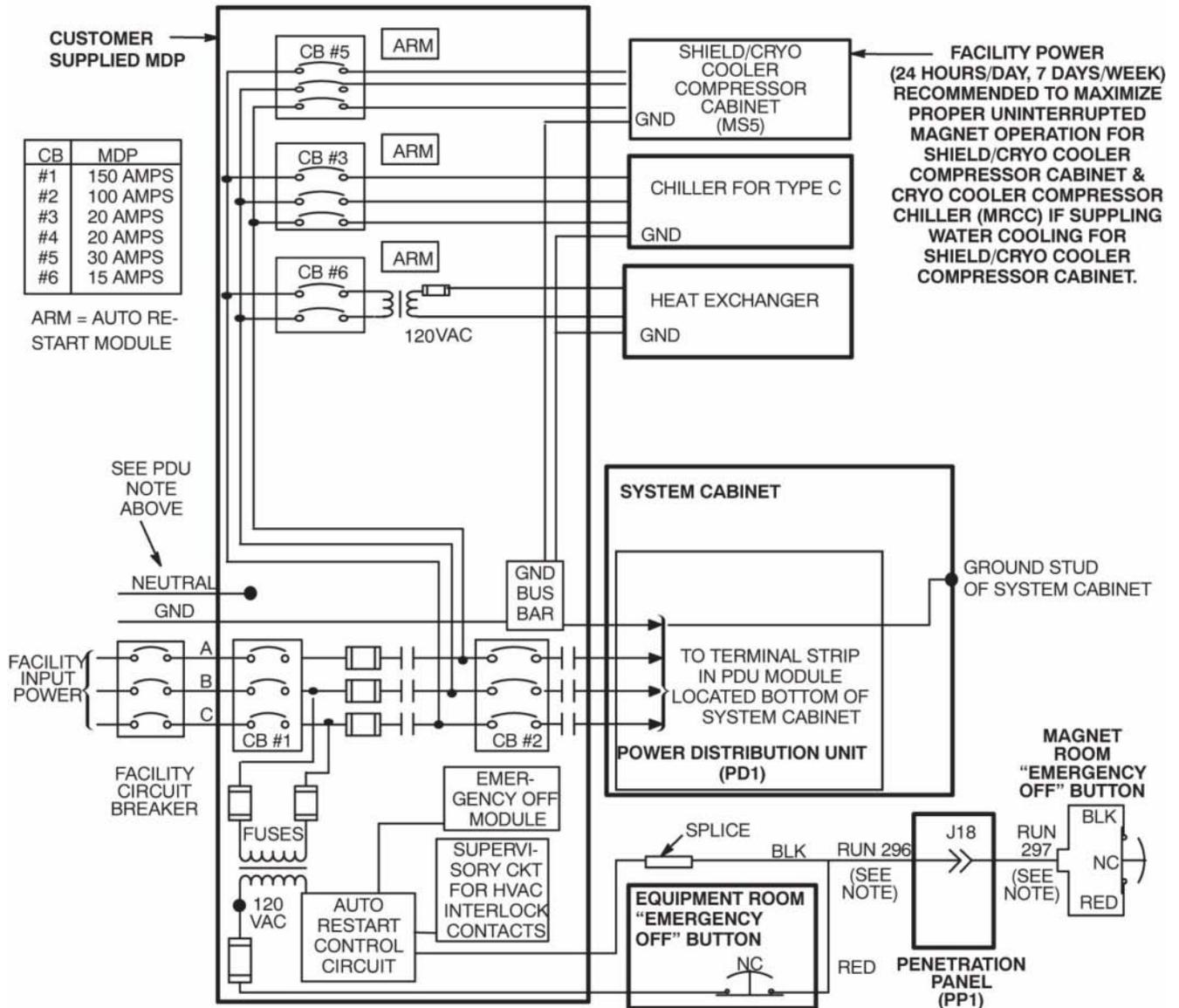
TWO REMOTE EMERGENCY "OFF" BUTTONS ARE SUPPLIED WITH GE MDP OPTION, **EMERGENCY OFF BUTTONS ARE CUSTOMER SUPPLIED IF GE MDP OPTION NOT USED.**

CIRCUIT BREAKERS ARE PROVIDED FOR PDU, CHILLER FOR TYPE C, HEAT EXCHANGER, SHIELD/CRYO COOLER COMPRESSOR CABINET, MAGNET MONITOR EQUIPMENT CIRCUITS.

ALL BRANCH CIRCUITS DROP OUT ON LOSS OF POWER. TYPE C CHILLER, HEAT EXCHANGER, SHIELD/CRYO COOLER COMPRESSOR CABINET, & MAGNET MONITOR EQUIPMENT AUTOMATICALLY RESTART AFTER 3 SEC TIME DELAY UPON RESTORATION OF POWER. EMERGENCY OFF LOCKS OUT ALL CONTACTORS.

IF 3 PHASE WYE WITH NEUTRAL AND GROUND (5 WIRE SYSTEM) INPUT USED THEN NEUTRAL MUST BE TERMINATED INSIDE THE MAIN DISCONNECT PANEL AND NOT BROUGHT TO THE POWER CABINET

SUPERVISORY CIRCUIT FOR HVAC INTERLOCK CONTACTS OPEN ON LOSS OF DC POWER OR EMERGENCY OFF OPERATION.



9.9.4 General Information of Type C Configuration

9.9.4.1 Shipping Notice of Chiller

Locally supplied Chiller including valves, copper pipes, and hoses must be prepared before Magnet shipment. Refer to [Illustration 3-24](#) for Cooling Configuration.

Otherwise, it will impact the Installation schedule.

9.9.4.2 Minimum Room Size of Equipment Room

Minimum Room Size of Equipment Room for Type C is the same as Type A (with Outdoor Cryo compressor and MRCC).

Table 3-17: Equipment Room Finished Minimum Values for Type C Configuration

Equipment Room Finished Minimum Values for Type C Configuration	
W x D	Area
ft-in. (m)	ft ² (m ²)
8.9 x 8.2(2.7 x 2.5)	73.0 (6.75)

Refer to [Room Sizes](#) for other information about Room Size.

NOTE: Equipment Room must be prepared for Type C configuration because of the noise of Water Cooled GWHX (Heat Exchanger).

9.9.4.3 Air Cooling for Type C Configuration

Water Cooled GWHX Heat Output is as follows.

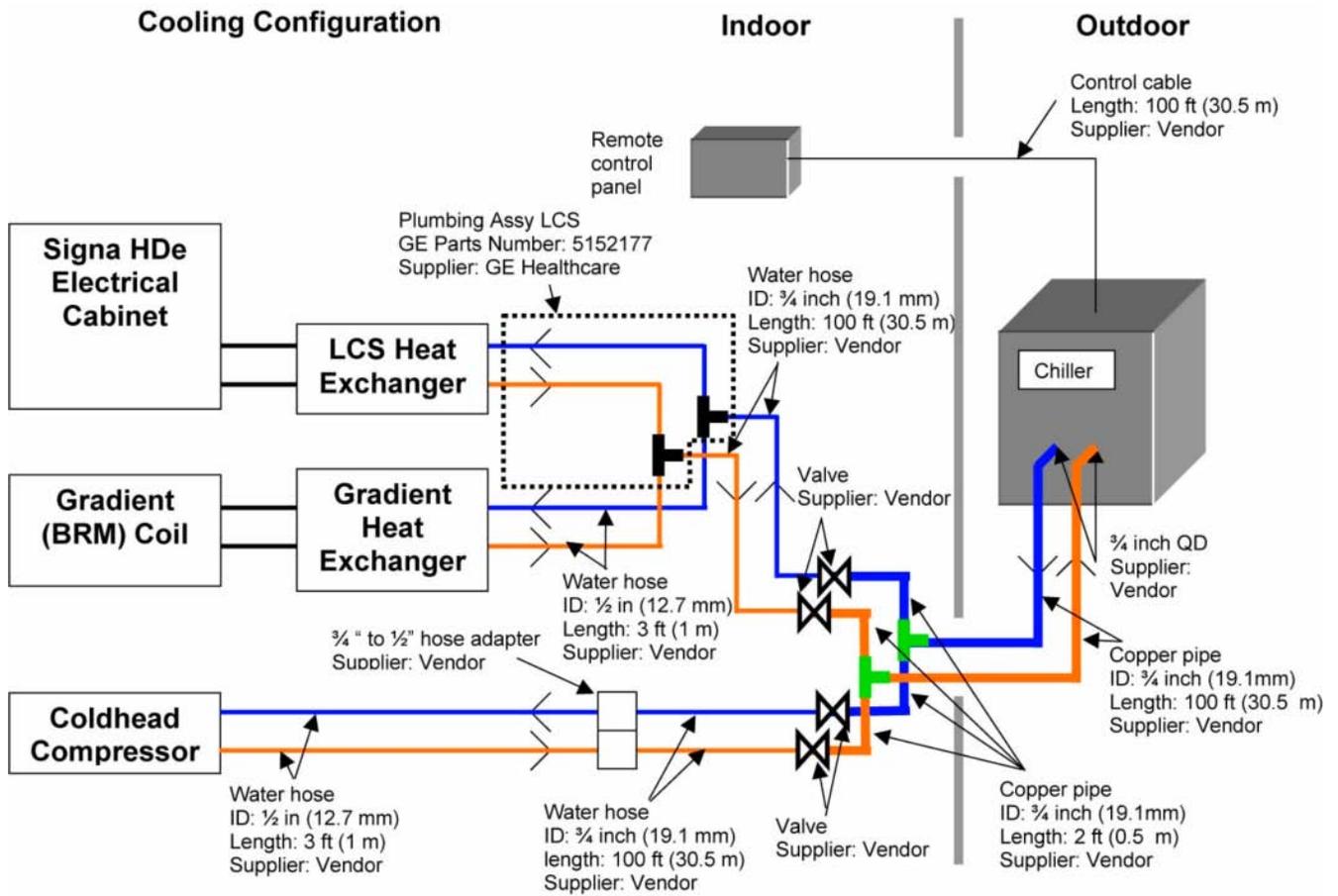
- 1707 BTU/hr (500 Watt)

Consider the air cooling by this value and by referring to [Chapter 5, Air Cooling](#).

9.9.4.4 Cooling Configuration for EU

[Illustration 3-24](#) shows Cooling Configuration for EU.

Illustration 3-24: Cooling Configuration



9.9.4.5 INTERCONNECT DIAGRAM



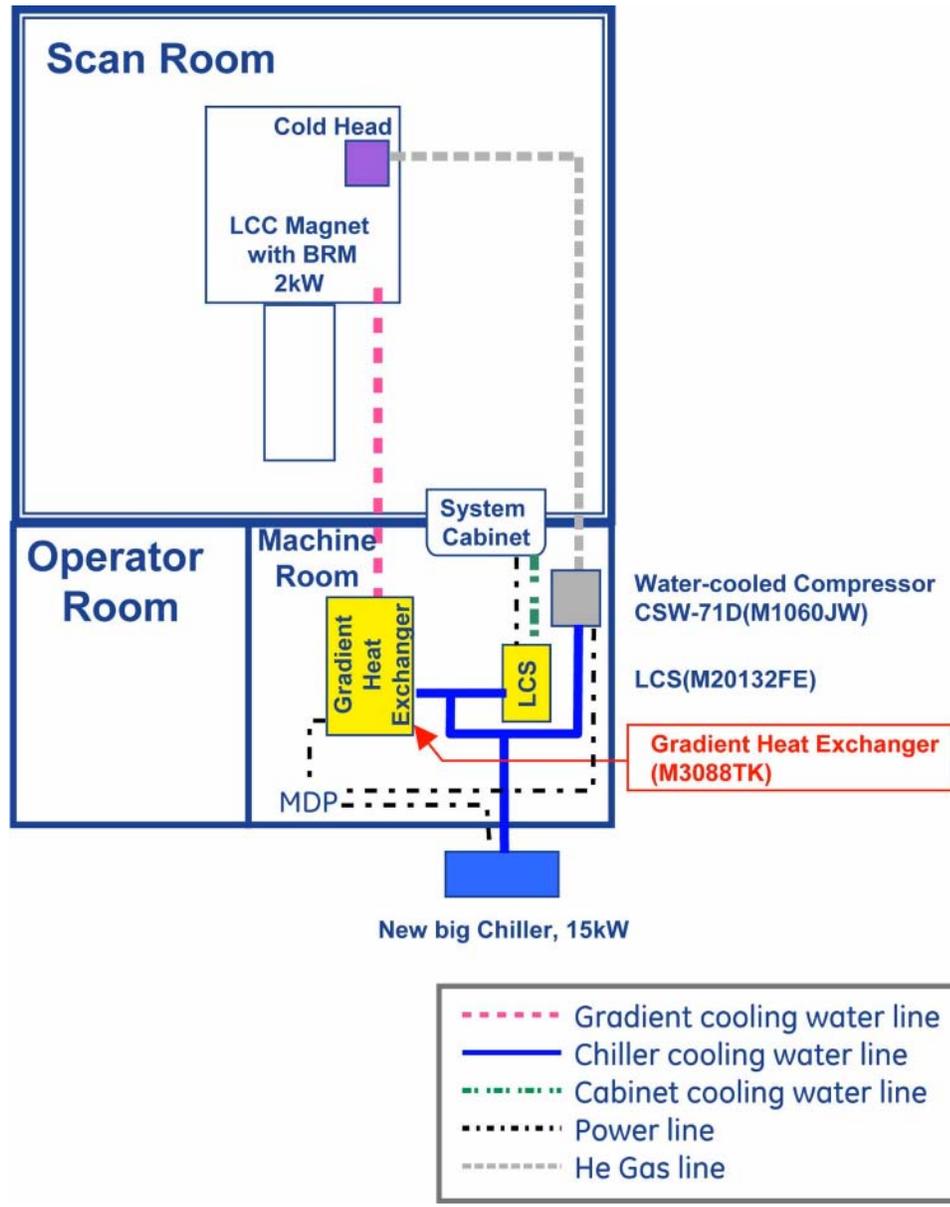
NOTICE

Heat exchanger power must be supplied from MDP. Do NOT connect the power cable to System Cabinet.

Regarding MDP, refer to [Main Disconnect Panel \(MDP\) Requirements For Type C \(EU Only\)](#)

NOTE: Cable length of Heat Exchanger is 9.1m (30ft).

Illustration 3-25: INTERCONNECT DIAGRAM



10 Architectural Reminders

1. Pay attention to isogauss limits, not only for placement of equipment in rooms, but also for isogauss limits with respect to outside environment.
2. The customer is responsible for establishing protocols to warn persons with cardiac pacemakers, neurostimulators, and biostimulation devices of the potential danger of entering magnetic fields greater than 5 gauss (exclusion zone).
3. Due to the periodic cryogen servicing of the magnet, consideration must be given to the delivery route of the cryogens to the Magnet Room. The service route should be level and therefore steps or steep ramps must be avoided. Maximum acceptable incline along dewar delivery route is 1:12 (5°).
 - a. Cryogen dewars must not be stored within the Magnet Room due to the safety issues of seismic considerations, spillage effects, fire hazards and explosive effects of compressed gas. Also the magnetic field inhomogeneity is affected by the physical shape of the non-magnetic dewars. If the magnet is shimmed with no dewars in the Magnet Room, the magnetic field inhomogeneity will slightly change once dewars are moved into the room (or vice versa). All dewars must be stored outside of the Magnet Room and more than 10 ft (3.05 m) from isocenter of the magnet in all directions.
 - b. Means must be provided to secure gas cylinders used for cryogen transfills in an upright position using a removable chain or strap. This is to prevent the cylinders from falling, which may cause injury or damage.
4. If elevators are to be used along cryogen delivery route, verify that elevator dimensions and weight capacity is sufficient to handle the cryogen dewars. Also, elevator must be dedicated with restricted access during cryogen transport (will not allow stops between initial start and final floor destination).
5. The operator seated at the Operator Workspace should have an unobstructed view of the patient on the transport table when table is docked to the magnet. Refer to Acoustics Background since viewing window location and material may impact site acoustics.
6. It is recommended that the Magnet Room viewing window be of fine mesh screening material (as opposed to a "honeycomb-type pattern") for better visibility of the patient from the Operator Workspace. Refer to Acoustics Background since viewing window location and material may impact site acoustics.
7. Operators in Magnet Room must have easy access to the scan control switches located on both front side panels of the magnet enclosure.
8. A patient preparation/emergency area should be located near the Magnet Room and direct patient access must be available from the Magnet Room to the patient preparation/emergency area.
9. Customer provided and paid for telephone lines must be supplied for system installation and serviceability purposes per [System Monitoring and Support Connectivity](#).
10. Corrosive chemicals must not be stored or used in the Equipment Room. These include chemicals used for film processor storage tanks, processor chemical recovery systems, etc. Such chemicals can contribute to increased equipment failures, increased system downtime, and decreased reliability. Film processor equipment installation must meet the manufacturer's

requirements (e.g. ventilation specifications) and all applicable national and local codes. Also, consideration should be given to the location of this equipment and chemical fumes relative to human contact as it relates to locating this equipment and chemicals in the control area.

11. Recommend protecting floors while moving heavy pieces of equipment (e.g. System Cabinet, Body Coil Assembly, MRCC, etc).
12. There needs to be a site plan for the MR system replacement component delivery (i.e. corridor, doors, elevators, etc.) which meets the specifications in [Minimum Delivery Route Sizes and Capacity](#).

11 Floor Loading and Weights

11.1 MR System Components



NOTICE

It is the responsibility of the customer to obtain any and all approvals necessary for the construction of equipment support and seismic anchoring.

Listed in [Table 3-18](#) are the weights, floor loading, and normal mounting methods for the Signa HDe 1.5T MR system components.

Table 3-18: Signa HDe 1.5T System Components Floor Loading

Component	Weight & Dimensions See Table 3-19 Note 2 & 5	Normal Mounting Method
1.5T LCC Magnet, RF/Gradient Body Coils (BRM), and Enclosure including Table Dock and Rear Pedestal	See Table 3-19 Notes 1 & 3. Refer to Magnet and Enclosure	Magnet & Table Dock Asm. resting on base, for mounting requirements refer to <ul style="list-style-type: none"> with VibroAcoustic Damping option: without VibroAcoustic Damping option: Rear Pedestal floor mounting must meet requirements in Flooring .
Patient Table	See Patient Transport Table	Mobile
Blower Box	See Blower Box	Anchor to floor or shelf; see Table 3-19 Note 6 for additional mounting requirements.
Shield/Cryo Cooler Compressor Cabinet (See Table 3-19 Note 4)	See Shield/Cryo Cooler Compressor Cabinet	Set on floor and rest on casters.
Operator Workspace Table with LCD display & GOC Computer Cabinet	See Operator Workspace	Table set on floor on leveling pads & Cabinet set on floor and rest on casters.
System Water Cooling Equipment Configurations		
MR Common Chiller (MRCC)* (WC1) for Type A See Table 3-19 Note 4	See MR Common Chiller (MRCC)	Indoors: Set on floor and rest on casters. Outdoors: Bolted to mounting pad on ground level external to building or roof mounting pad or structure.
Water Chiller for System Cabinet - LCS for Type A (WC2) Table 3-19	See Water Chiller For System Cabinet - LCS (WC2)	Set on floor on casters
Water Chiller for Gradient Coil(WC1) for Type B. See Table 3-19 Note 4	See Water Chiller For BRM Gradient Coil (WC1)	Set on floor on casters
Water Chiller for System Cabinet - MCS(WC2) for Type B. Table 3-19	See Water Chiller For System Cabinet (Air Cooled Type)	Set on floor on casters

Table 3-19: NOTES FOR PRECEDING TABLE

Notes	
* Optional Equipment	
** Dewar specifications may vary. Check with cryogen supplier for exact weight and dimensions	
1.	Weight of 1.5T LCC Magnet with HDe Enclosure, RF/Gradient (BRM) Body Coil, VibroAcoustic Damping Option mats, and cryogens is 13,116 lbs (5949 kg). Weight of 1.5T LCC Magnet with EXCITE HDe Enclosure, RF/Gradient (BRM) Body Coil, and cryogens is 12,606 lbs (5719 kg). The Rear Pedestal installed weight is 153 lbs (69.4 kg).
2.	Consult a structural engineer on method of calculating proper weight/unit area for floor loading.
3.	Refer to Minimum Delivery Route Sizes and Capacity for Gradient Coil Assembly replacement weight and dimension requirements.
4.	The MR System requires water cooling for the Gradient Coil, System Cabinet, and the Shield/Cryo Cooler Compressor. <ul style="list-style-type: none"> ○ Gradient Coil water cooling must be supplied by Water Chiller (WC1) supplied with the MR system to prevent contamination/damage to the coil and for proper image quality. ○ System Cabinet water cooling must be supplied by Water Chiller (WC2) supplied with the MR system to prevent contamination/damage to the coil and for proper image quality. ○ The Shield/Cryo Cooler Compressor water cooling can be provided by a separate MRCC or by customer provided facility water cooling, refer to Chapter 5, Shield/Cryo Cooler Water Cooling For Site Provided Water Cooling. Sites requiring seismic anchoring by code for MRCC option should have the site architect and engineer review the response spectra and/or International Builders Code (IBC) for their location and then contact MRCC Service Provider for assistance in seismic planning of the site. The Service Provider for the chiller is listed in MRCC Siting Considerations.
5.	The center of gravity for MR system components are given in the illustrations for use in seismic calculations. Contact your local GE Healthcare Project Manager, Installations for seismic information if the MR system equipment is required by code to be anchored.
6.	Blower Box mounting must meet the requirements in the following: <ul style="list-style-type: none"> ○ Chapter 8, Anchor Hardware For MR Equipment Inside RF Shield ○ Chapter 8, Physical Characteristics ○ Chapter 8, Clamping Force (Tension) and Pull Test ○ Chapter 8, RF Shield Integrity ○ Chapter 8, Electrical Isolation

11.2 Magnet and Dock Mounting

11.2.1 Magnet Installed With VibroAcoustic Damping Option

The LCC Magnet installed with the VibroAcoustic Damping Option (M1060MA) has the VibroAcoustic Damping mats resting directly on the Magnet mounting area floor. The LCC Magnet is leveled and bolted to the VibroAcoustic mats stainless steel top plate. The VibroAcoustic mats do not require anchors into the Magnet Room floor in non-seismic areas. For additional Magnet Room floor requirements for VibroAcoustic mats refer to [Chapter 8, Magnet Room Floors](#).

The Table Dock is still required to be anchored to the Magnet Room floor per the RF Shielded Room chapter, Anchor Hardware Requirements sections:

- [Chapter 8, Anchor Hardware For MR Equipment Inside RF Shield](#)
- [Chapter 8, Physical Characteristics](#)
- [Chapter 8, Anchor Location And Installation](#)
- [Chapter 8, Clamping Force \(Tension\) and Pull Test](#)
- [Chapter 8, RF Shield Integrity](#)
- [Chapter 8, Electrical Isolation](#)

11.2.2 Magnet Installed Without VibroAcoustic Damping Option



NOTICE

It is the customer's responsibility to coordinate magnet mounting methods with the RF shielded room vendor to prevent RF leaks and secondary grounding problems.

The LCC Magnet installed without the VibroAcoustic Damping Option (M1060MA) must be bolted to the floor; refer to [Chapter 5, Vibration](#). Bolt hole openings in the magnet base are to be used to anchor the magnet, refer to RF Shielded Room chapter, Anchor Hardware Requirements sections:

- [Chapter 8, Anchor Hardware For MR Equipment Inside RF Shield](#)
- [Chapter 8, Physical Characteristics](#)
- [Chapter 8, Anchor Location And Installation](#)
- [Chapter 8, Clamping Force \(Tension\) and Pull Test](#)
- [Chapter 8, RF Shield Integrity](#)
- [Chapter 8, Electrical Isolation](#)

12 Components Dimensions

12.1 Component Dimensions

To assist in completing your room layout, refer to [Table 3-20](#) for list of component Illustrations.

Table 3-20: Signa HDe 1.5T System Component Illustrations List

Illustration Name	Illustration Location
<ul style="list-style-type: none"> • Signa HDe 1.5T LCC Magnet (Minimum Service Area) • Signa HDe 1.5T LCC Magnet Enclosure Front And Rear Views • Signa HDe 1.5T LCC Magnet Enclosure Cable Access • 1.5T LCC Magnet Load Pattern 	Magnet and Enclosure
Shield/Cryo Cooler Compressor Cabinet For Type A (MS5)	Shield/Cryo Cooler Compressor - Type A
Shield/Cryo Cooler Compressor Cabinet For Type B (Air Cooled Type) (MS5)	Shield/Cryo Cooler Compressor Cabinet For Type B (Air Cooled Type)
Shield/Cryo Cooler Compressor Cabinet For Type B (Water Cooled Type) (MS5)	Shield/Cryo Cooler Compressor Cabinet For Type B (Water Cooled Type)
<p>NOTE: An MRCC option can be used to provide BRM water cooling. MRCC is used for Type A configuration.</p> <ul style="list-style-type: none"> • MR Common Chiller (MRCC) • MRCC Outdoor Mounting • Remote Control Panel (RCP) For MRCC 	MR Common Chiller (MRCC)
Water Chiller For System Cabinet - LCS for Type A (WC2)	Water Chiller For System Cabinet (LCS) Type A
Water Chiller For System Cabinet - MCS for Type B (WC2)	Water Chiller For System Cabinet (MCS) Type B
Water Chiller (WC1) For BRM Gradient Coil Cooling Water For Type B	Water Chiller For BRM Gradient Coil Cooling Water For Type B
Blower Box (MG6)	Blower Box
System Cabinet and Penetration Panel	System Cabinet
Mesh Shield and System Cabinet Cover	Mesh Shield and System Cabinet Cover
Penetration Panel	Penetration Panel
Magnet Monitor (MSM1)	Magnet Monitor
Patient Transport Table (PT1)	Patient Transport Table
<ul style="list-style-type: none"> • Operator Workspace (OW1) Overall Dimensions • GOC Computer Cabinet (OW1 A2) • Operator Worspace Components Position on Table Top - 23 Inch LCD • Operator Worspace Components Position on Table Top - Keyboard 	Operator Workspace
Pneumatic Patient Alert Control Box (PA1)	Pneumatic Patient Alert
SPT Phantom Set Shipping/Storage Cart	SPT Phantom Set Shipping/Storage Cart
Magnet Rundown Unit (MS4)	Magnet Rundown Unit

Illustration Name	Illustration Location
Main Disconnect Control E4503AT Option	Main Disconnect Panel
DC Lighting Controller Option	DC Lighting Controller Option
<ul style="list-style-type: none">Oxygen Monitor (OM1)Remote Oxygen Sensor Module (OM3)	Oxygen Monitor Option

12.2 Magnet and Enclosure

Table 3-21: Magnet & Signa HDe Enclosure List of Dimension Illustrations

Illustration Name	Illustration Number
Magnet Room Minimum Service Area	Table 3-22
Magnet Enclosure Front And Rear Views	Illustration 3-26
Magnet Mounting Detail	Illustration 3-27
Duct Information	Illustration 3-28, Illustration 3-29, Illustration 3-30

Table 3-22: Magnet Room Minimum Service Area

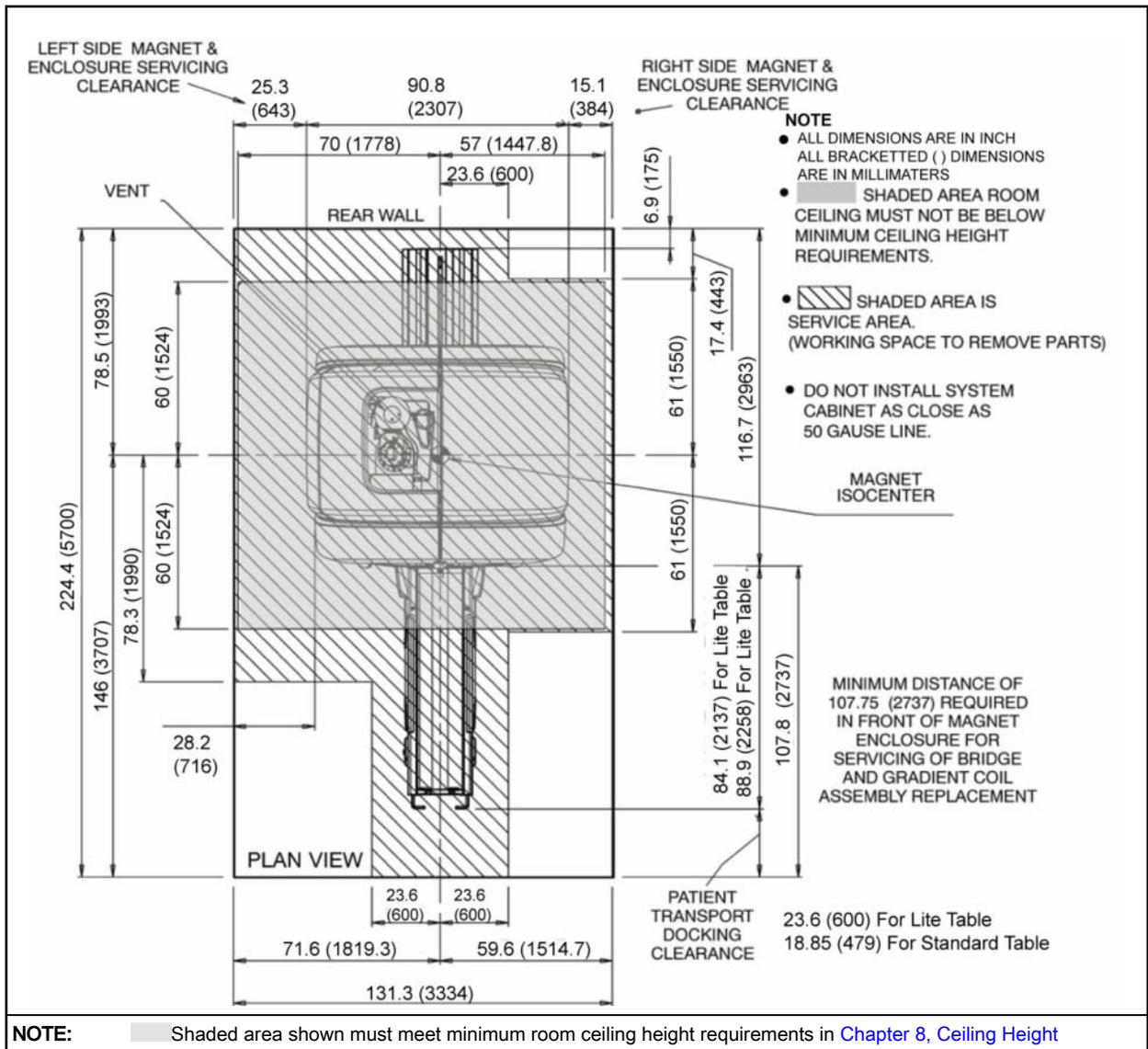


Illustration 3-26: Magnet Enclosure Dimensions

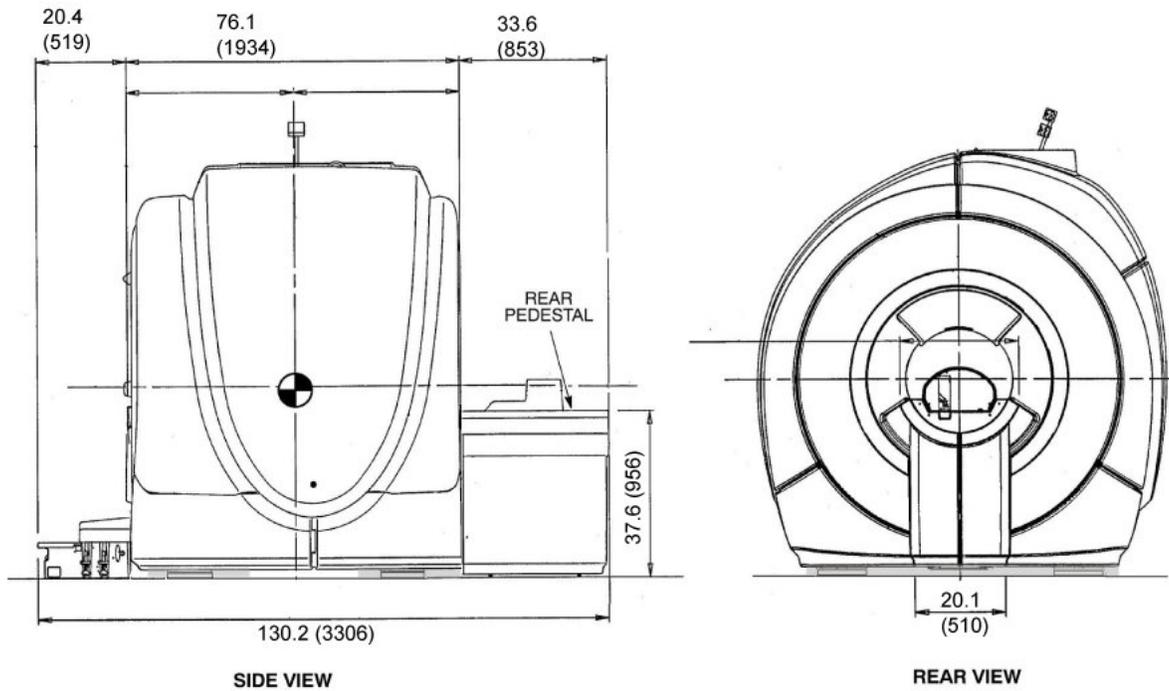
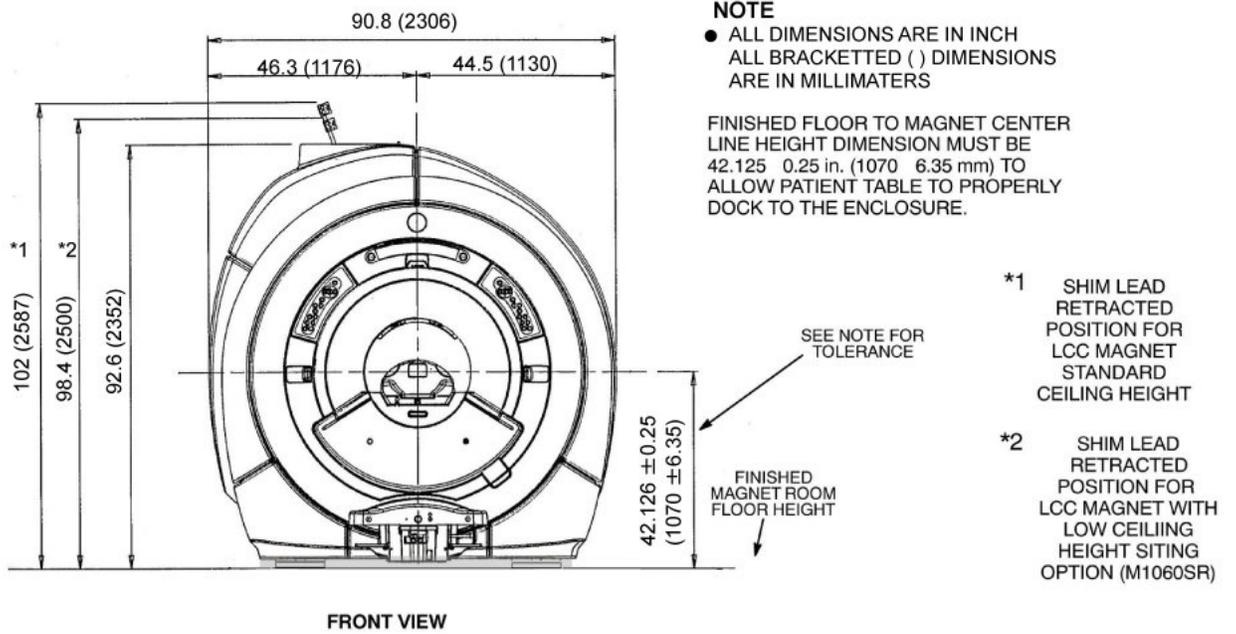


Illustration 3-28: Recommended Duct Example for minimum area

Recommended Duct Example for Minimum Room Layout:

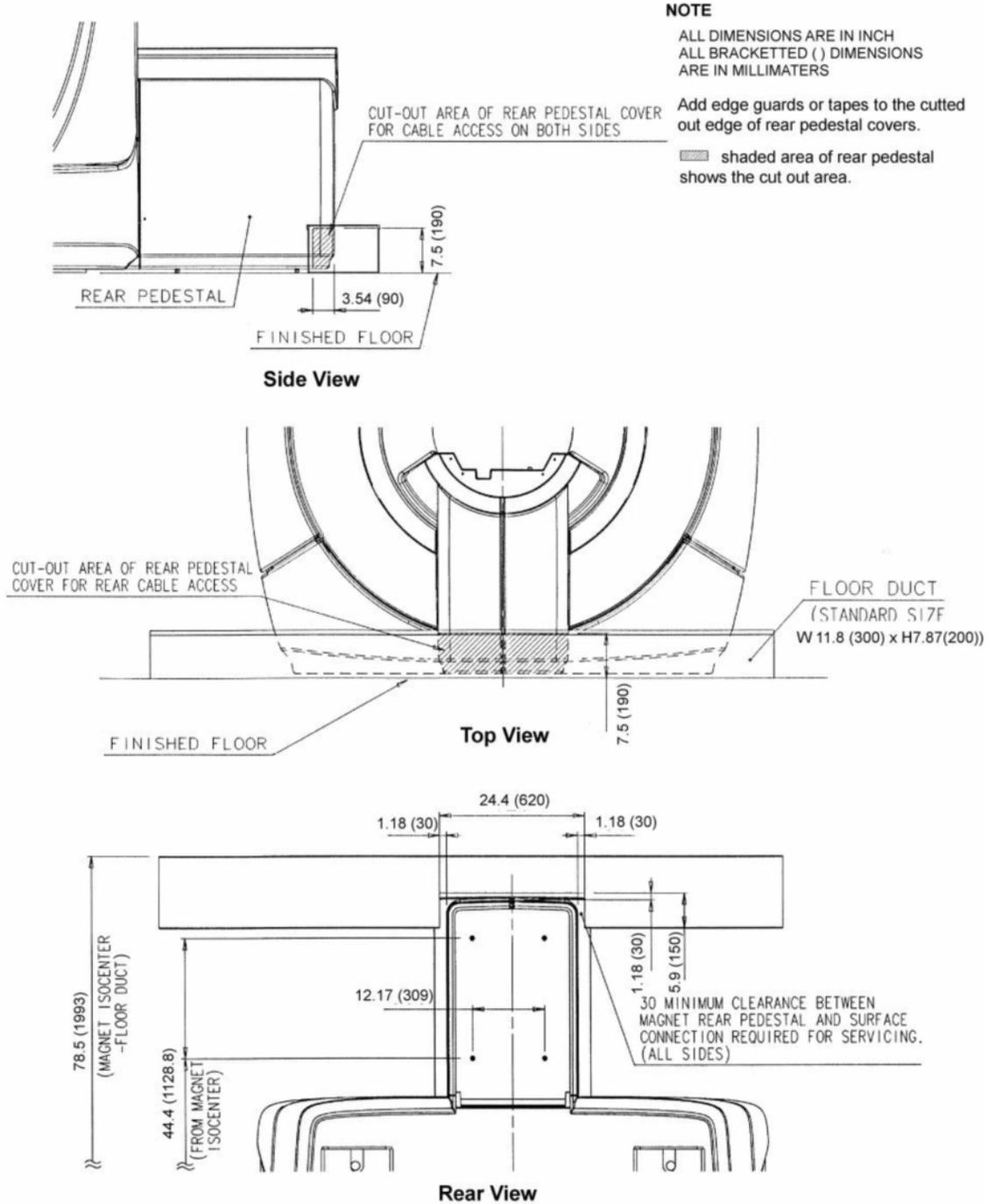


Illustration 3-29: Recommended duct example if there is enough room

Recommended Duct Example if there is enough room:

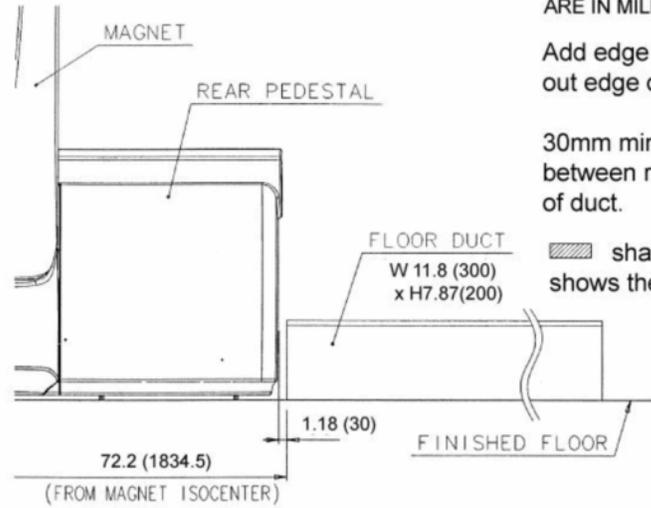
NOTE

ALL DIMENSIONS ARE IN INCH
 ALL BRACKETTED () DIMENSIONS
 ARE IN MILLIMETERS

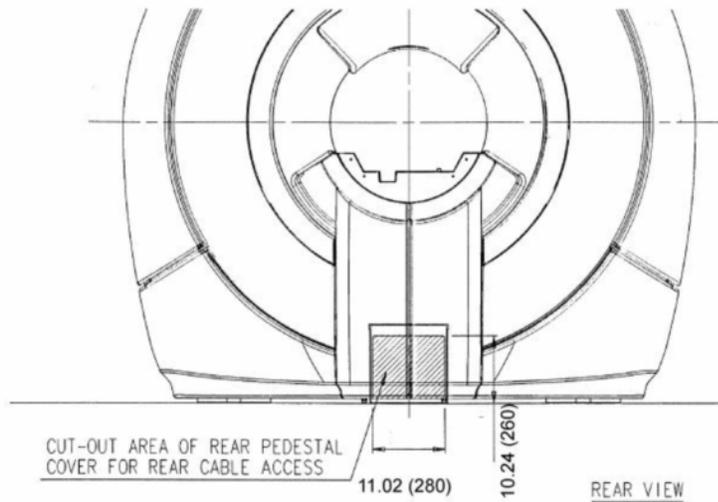
Add edge guards or tapes to the cutted
 out edge of rear pedestal covers.

30mm minimum clearance is required
 between rear pedestal and surface
 of duct.

shaded area of rear pedestal
 shows the cut out area.



Side View

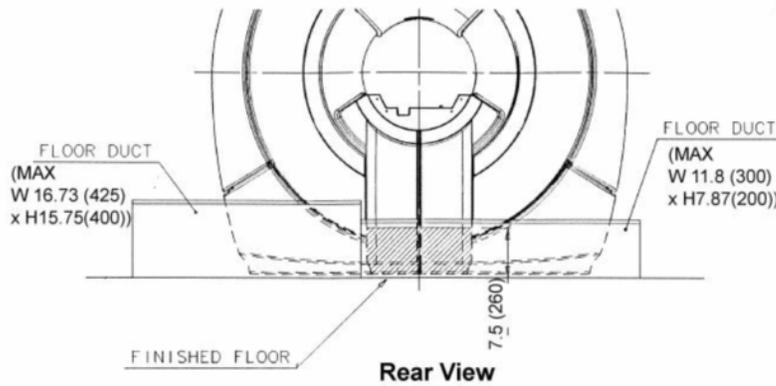


Rear View

Illustration 3-30: Limitation of Duct size for minimum Room layout

Limitation of Duct Size for Minimum Room Layout:

The following drawing shows the limitation of Duct size.
Do not exceed the following specification.
Otherwise, it will affect for servicing(replacement or maintenance).



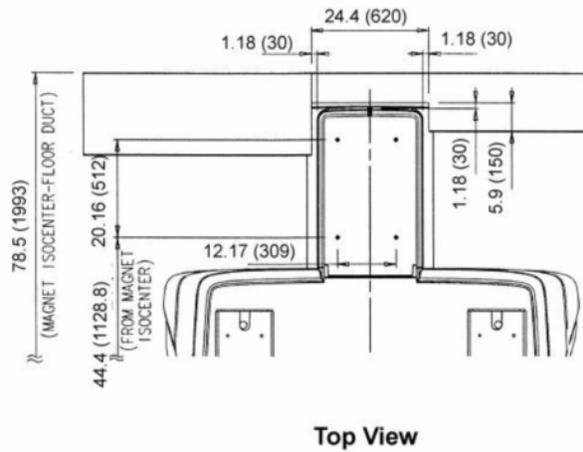
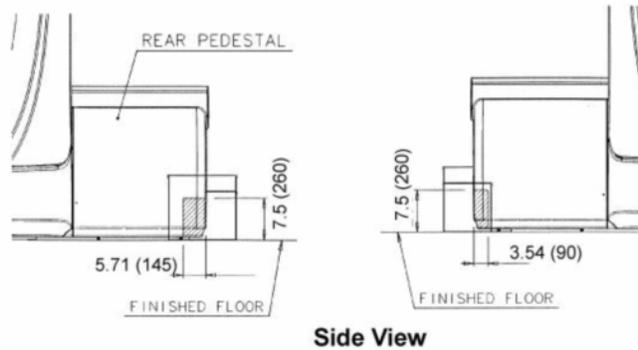
NOTE

ALL DIMENSIONS ARE IN INCH
ALL BRACKETTED () DIMENSIONS
ARE IN MILLIMETERS

Add edge guards or tapes to the cutted
out edge of rear pedestal covers.

30mm minimum clearance is required
between rear pedestal and surface
of duct (for all covers).

shaded area of rear pedestal
shows the cut out area.



12.3 Shield/Cryo Cooler Compressor - For Type A



NOTICE

CONSIDER THE INSTALLATION LOCATION OF THE SUMITOMO OUTDOOR COMPRESSOR SO THAT FIELD ENGINEER CAN SAFELY PROCEED WITH INSTALLATION AND MAINTENANCE WORK.

ALSO, INSTALLATION LOCATION OF THE SUMITOMO OUTDOOR COMPRESSOR MUST BE IN COMPLIANCE WITH NATIONAL AND LOCAL LABOR SAFETY CODES.

Illustration 3-31: CNA-61D-C OUTDOOR UNIT

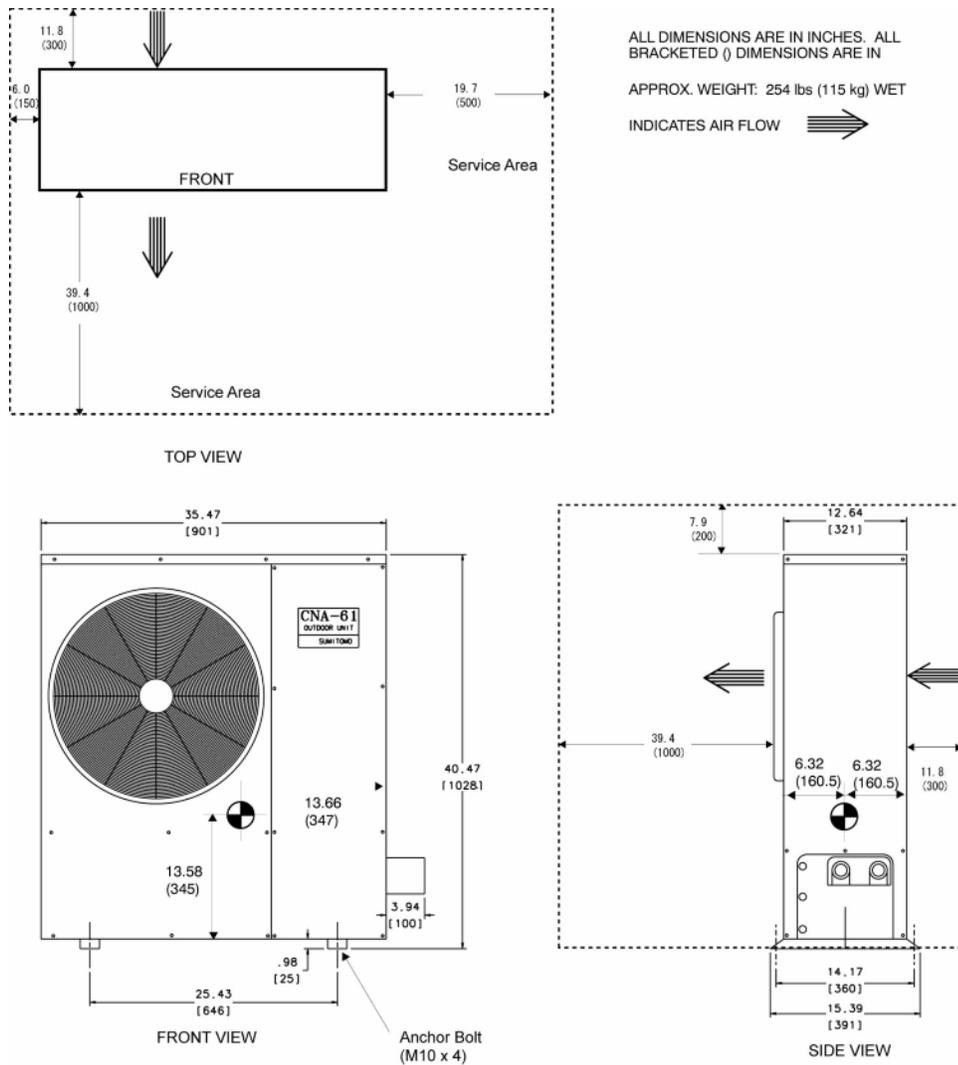
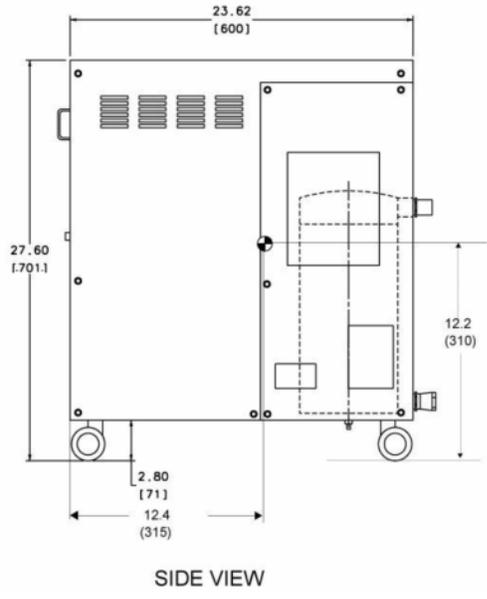
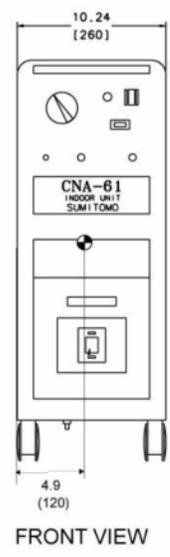
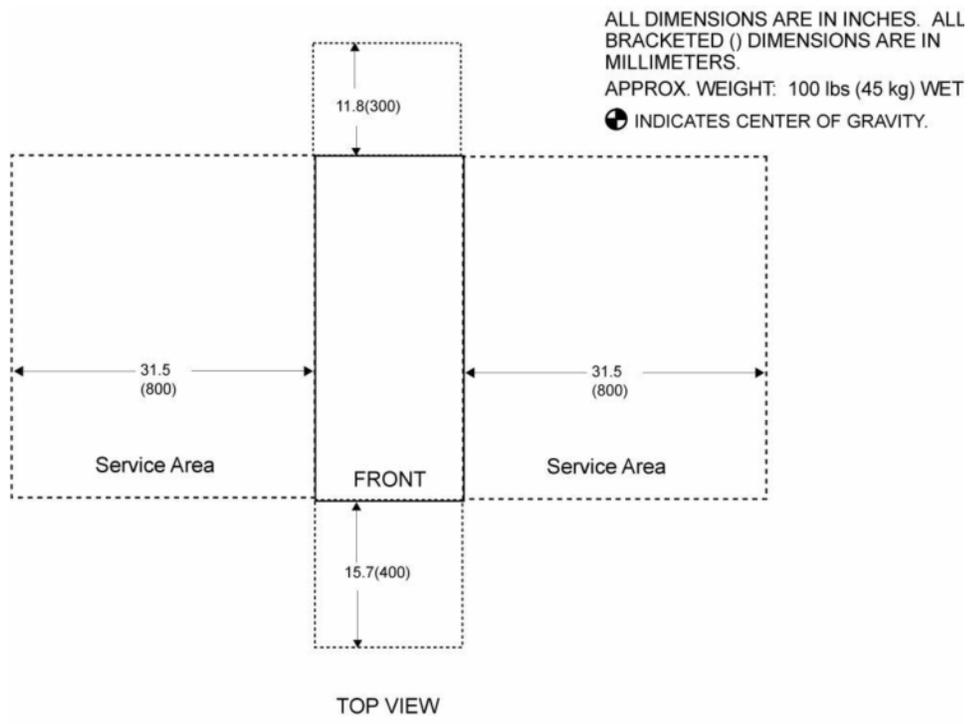


Illustration 3-32: CNA-61D-E INDOOR UNIT (Absorber)



12.4 Shield/Cryo Cooler Compressor (Water Cooled) - For Type B

NOTE: For water cooling specifications and materials needed for Shield/Cryo Cooler Compressor Cabinet, refer to [Chapter 5, Shield/Cryo Cooler Water Cooling For Site Provided Water Cooling](#).

Illustration 3-33: Cryo cooler Compressor F-50 (Introduced in July, 2008)

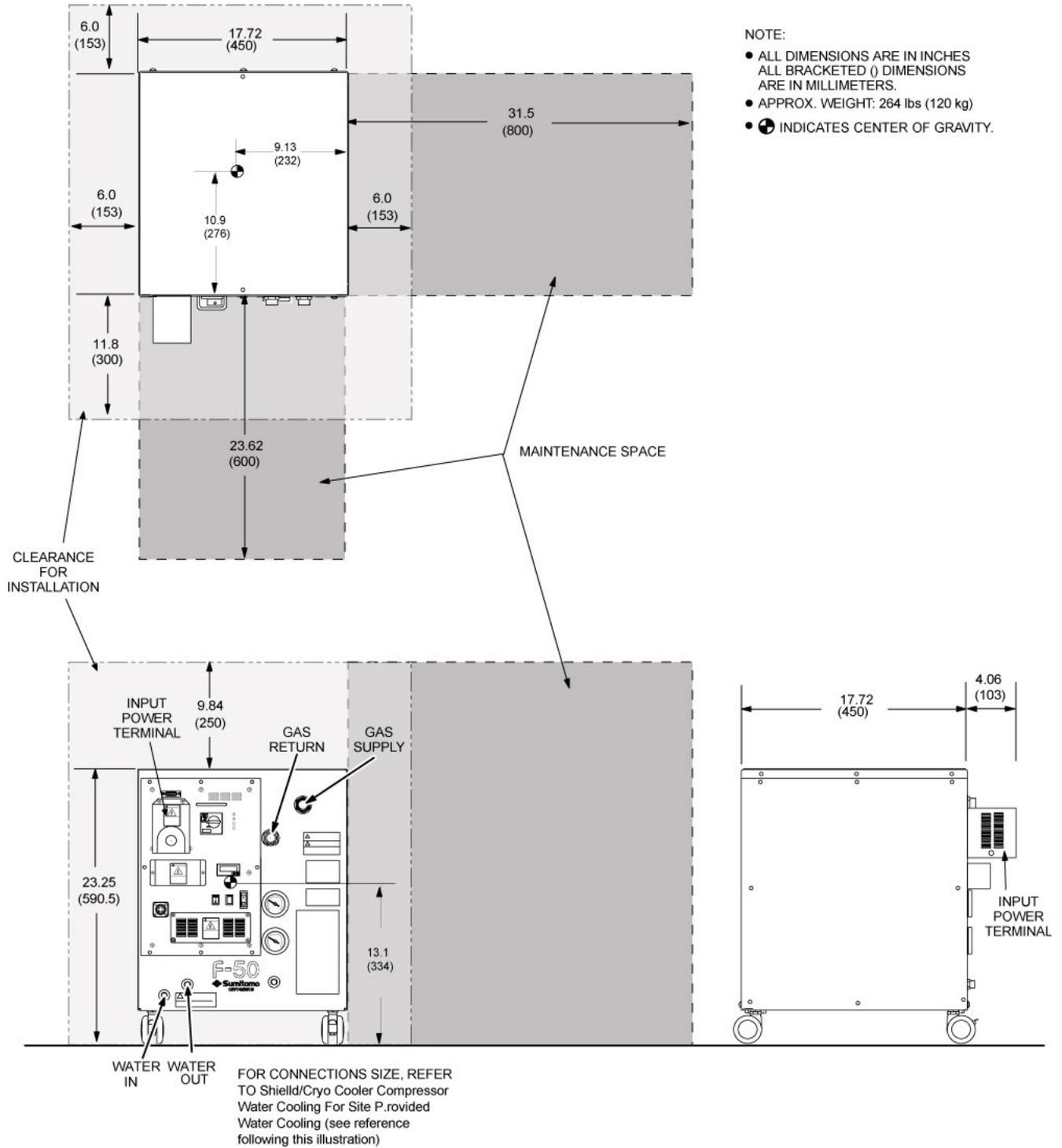
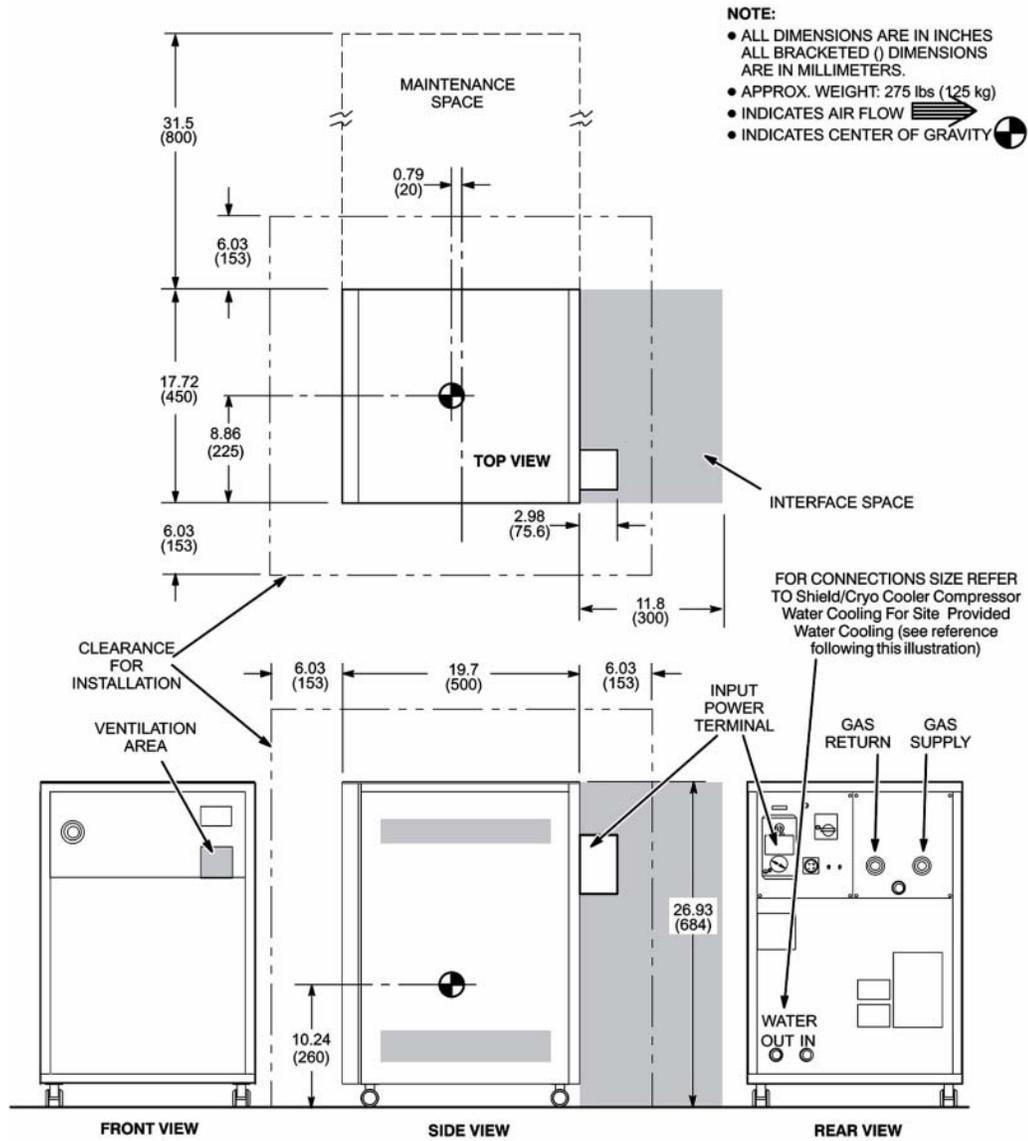
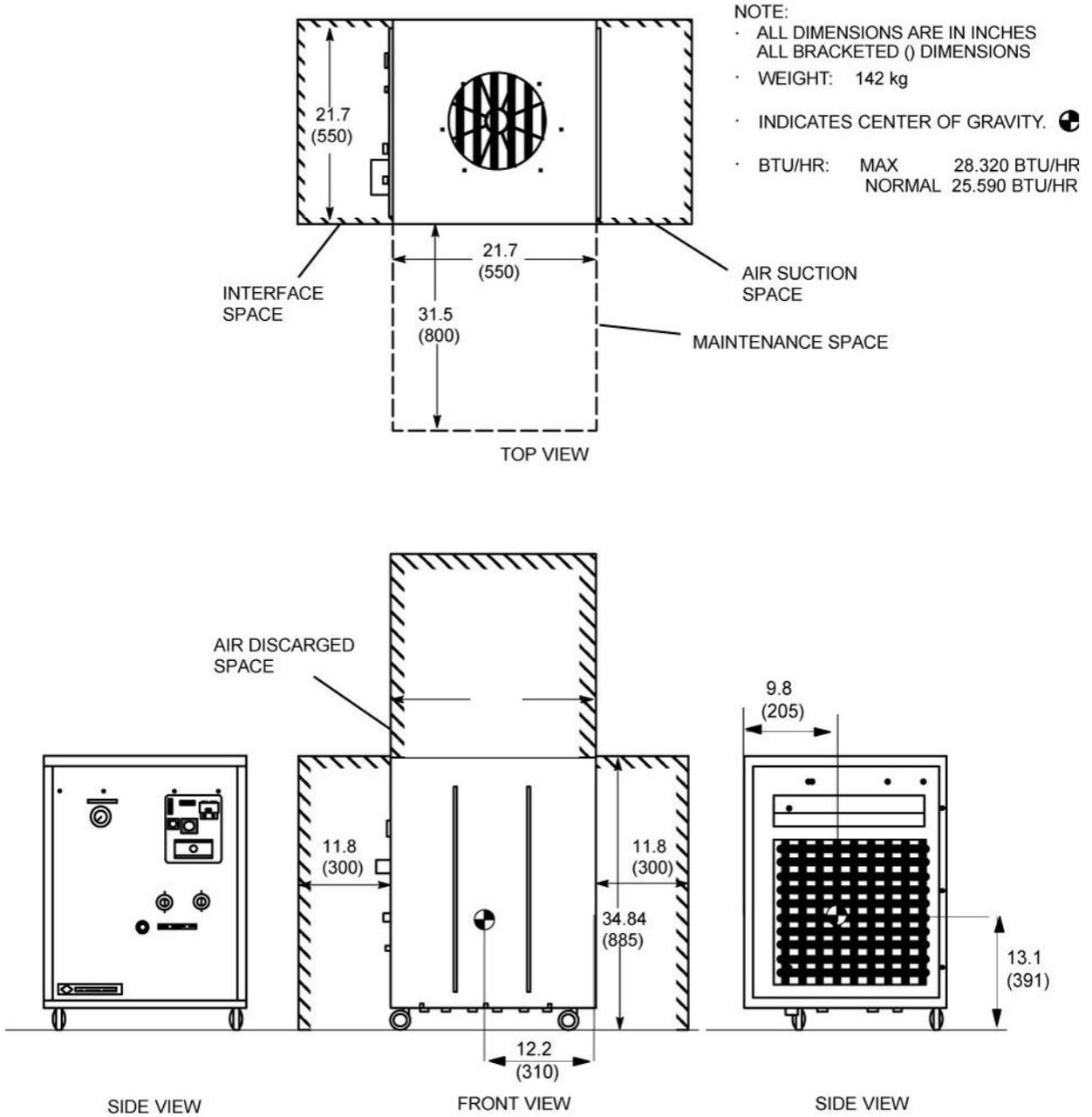


Illustration 3-34: Cryo cooler Compressor CSW-71D (This compressor was replaced to F-50 for forward production)



12.5 Shield/Cryo Cooler Compressor (Air Cooled) - For Type B

Illustration 3-35: CSA-71A COMPRESSOR UNIT



12.6 Main Disconnect Panel

Illustration 3-36: Signa Main Disconnect Panel E4503AT for Type B System Configuration

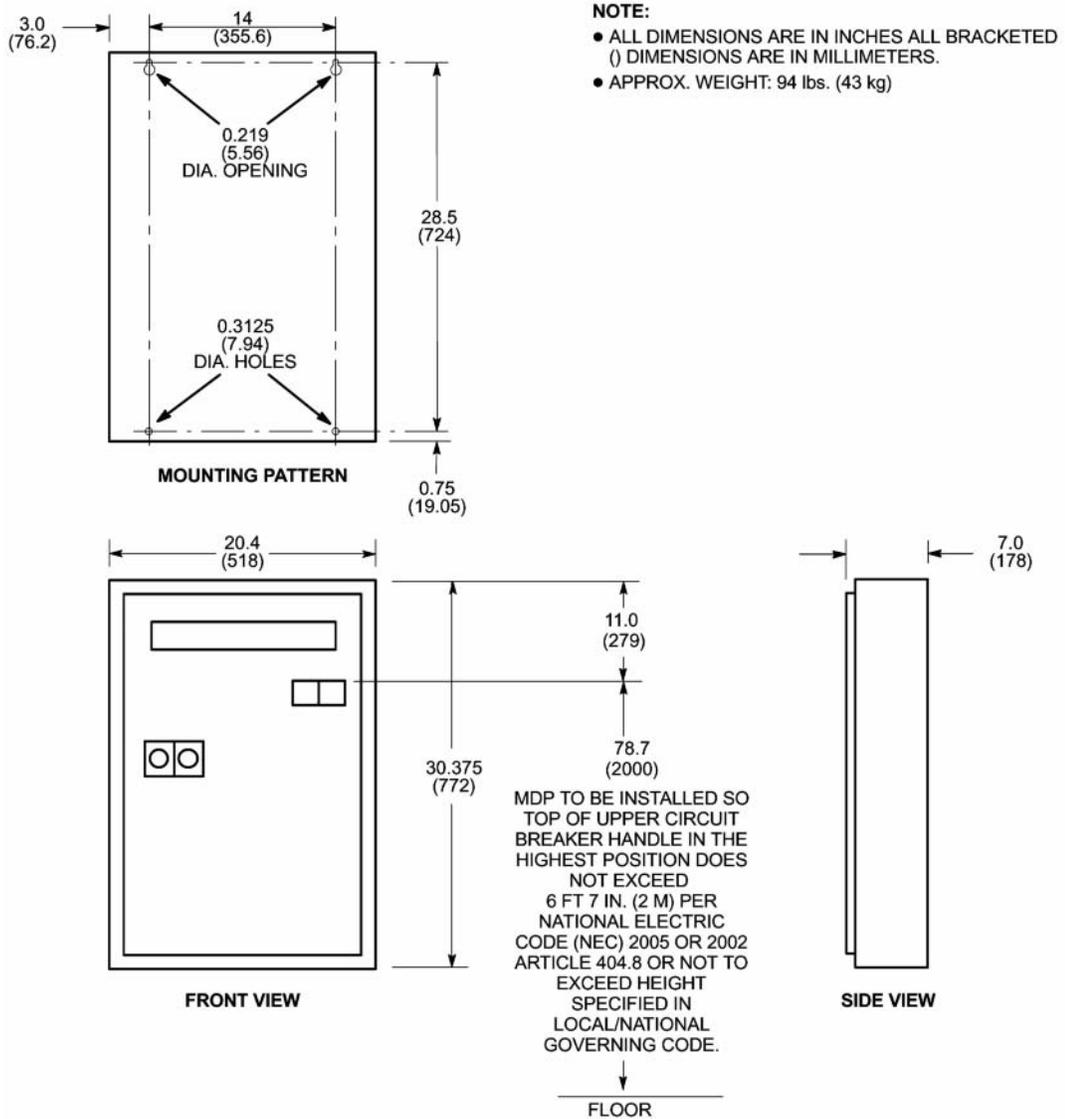
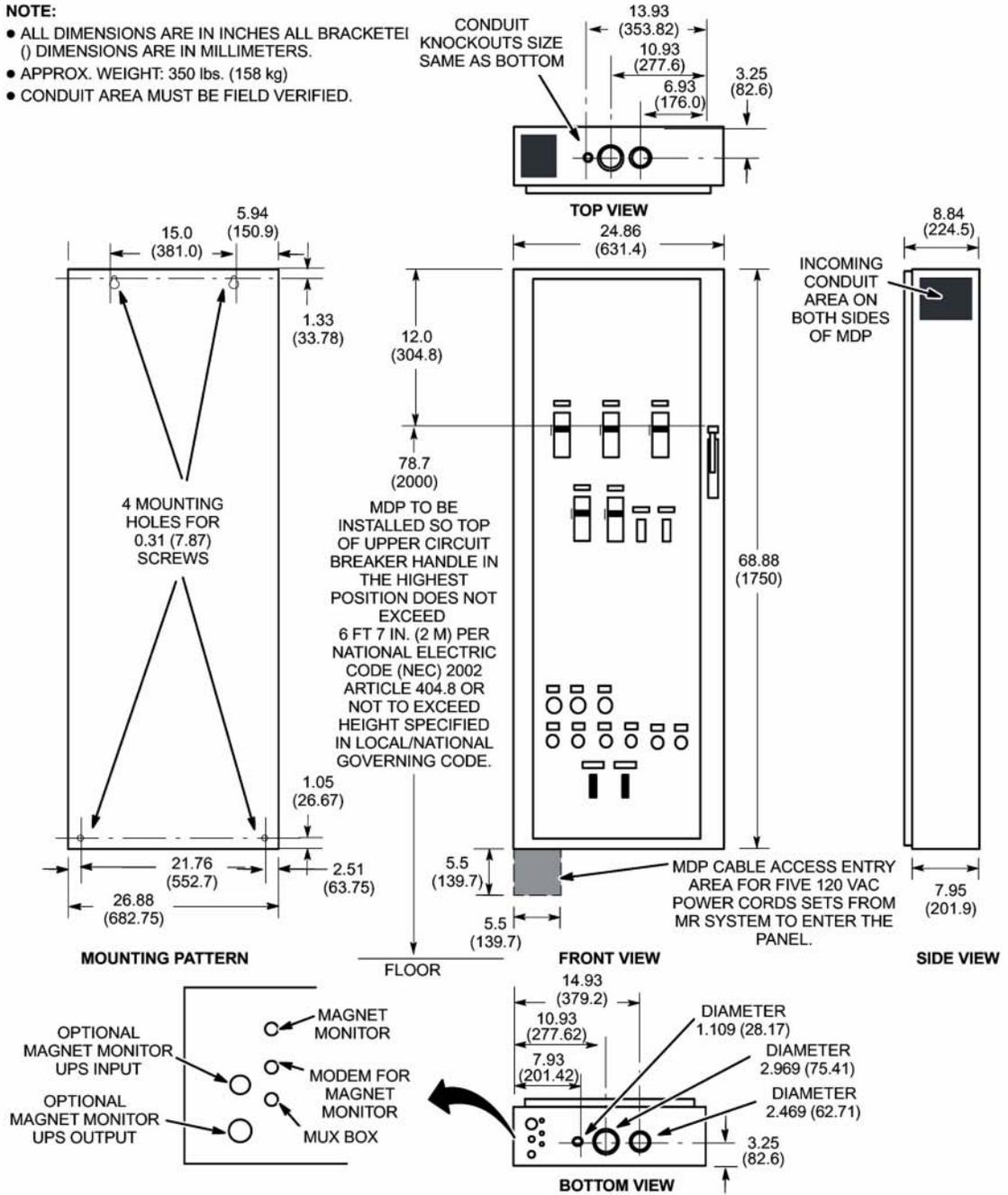


Illustration 3-37: Signa Main Disconnect Panel (MDP) M3088TM Option for Type A System Configuration

NOTE:

- ALL DIMENSIONS ARE IN INCHES ALL BRACKETED DIMENSIONS ARE IN MILLIMETERS.
- APPROX. WEIGHT: 350 lbs. (158 kg)
- CONDUIT AREA MUST BE FIELD VERIFIED.



12.7 MR Common Chiller (MRCC) for Type A Configuration

Table 3-23: MRCC List of Illustrations

Illustration Name	Illustration Number
MR Common Chiller (MRCC)	Illustration 3-38
MRCC Outdoor Mounting	Illustration 3-39
Remote Control Panel (RCP) For MRCC	Illustration 3-40

Illustration 3-38: MR Common Chiller (MRCC)

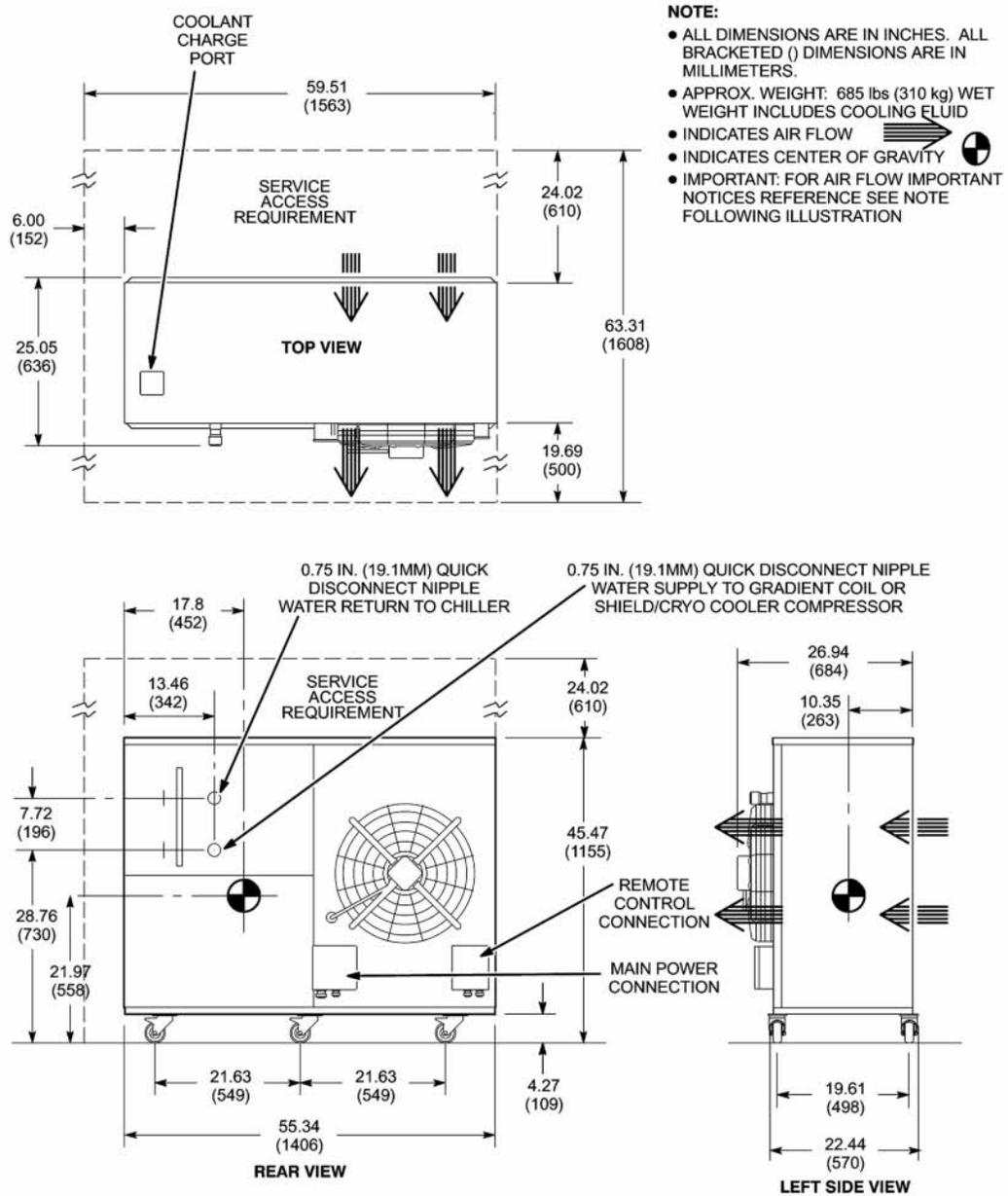
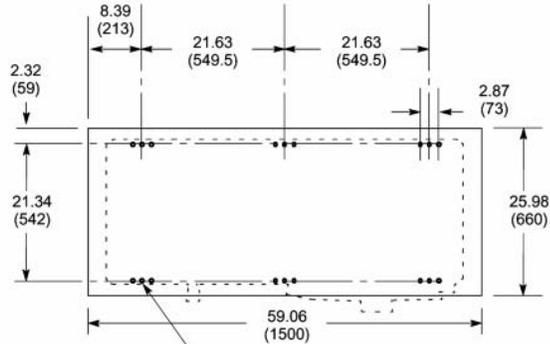


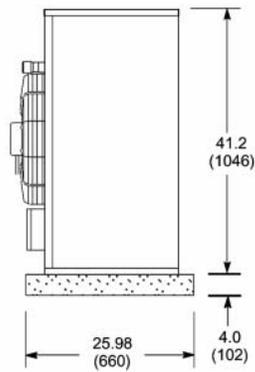
Illustration 3-39: MRCC Outdoor Mounting

NOTE:

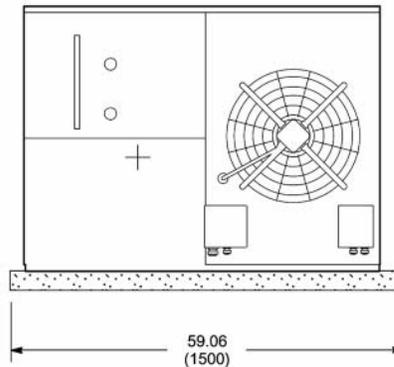
- ALL DIMENSIONS ARE IN INCHES. ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.
- GROUND INSTALLATION: REMOVE UNIT CASTERS AND USE SIX MIDDLE HOLES TO RIGIDLY BOLT DOWN ON CONCRETE PAD. CONCRETE PAD MUST HAVE LEVEL SURFACE (1 CM OVER 300 CM) AND PROPERLY SUPPORTED TO PREVENT SETTLING, MINIMUM 4 INCH (101.6 MM) DEEP CONCRETE PAD OF 2500 PSI CONCRETE REQUIRED. THE CONCRETE FOOTING SHOULD MEET OR EXCEED LOCAL CODE REQUIREMENTS.
- ROOF INSTALLATION: REMOVE UNIT CASTERS AND USE SIX MIDDLE HOLES TO RIGIDLY BOLT DOWN THE MRCC ON LEVEL SURFACE 0.4 INCHES OVER 118 INCHES (1 CM OVER 300 CM) ON ROOF.



0.35 (9) MOUNTING HOLE LOCATIONS (6 PLACES)
 REMOVE UNIT CASTERS AND USE SIX MIDDLE HOLES TO RIGIDLY BOLT DOWN MRCC

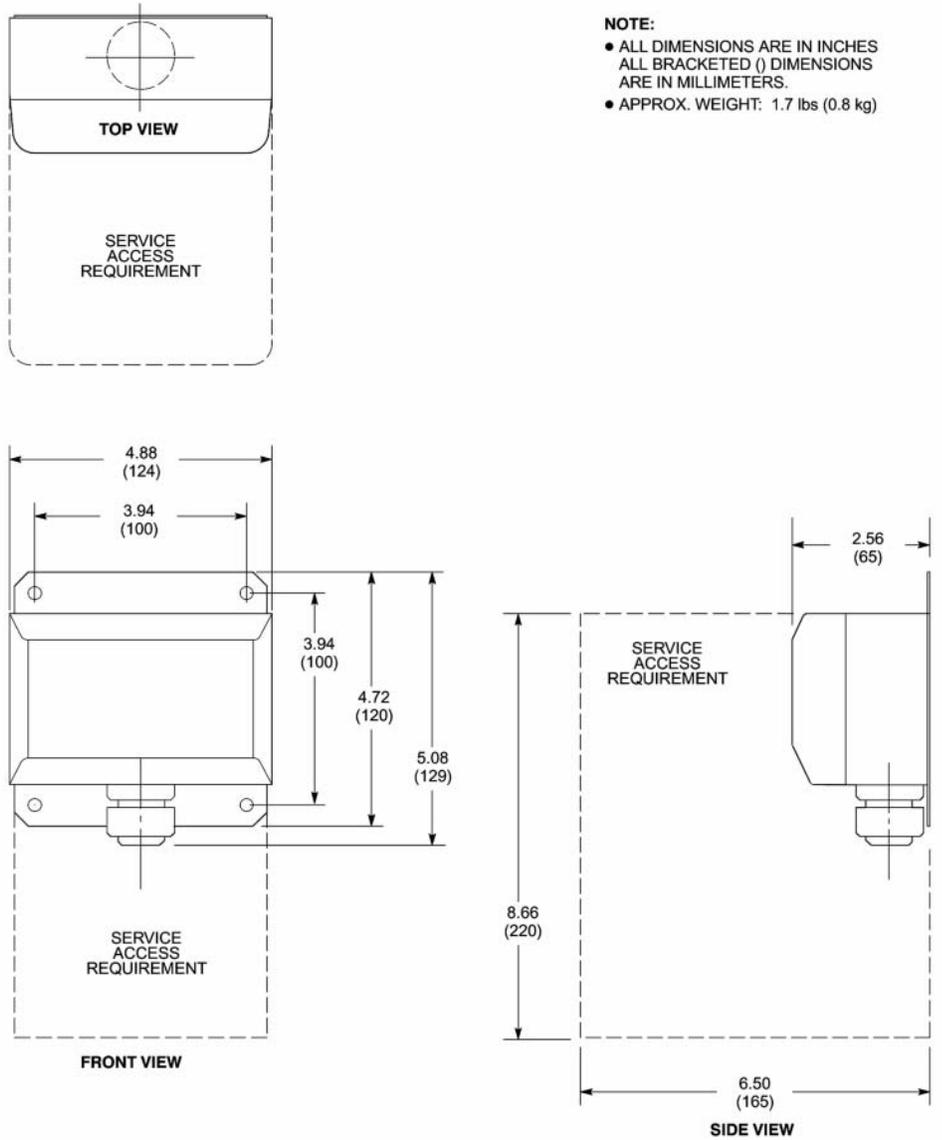


FRONT VIEW



LEFT SIDE VIEW

Illustration 3-40: Remote Control Panel (RCP) For MRCC



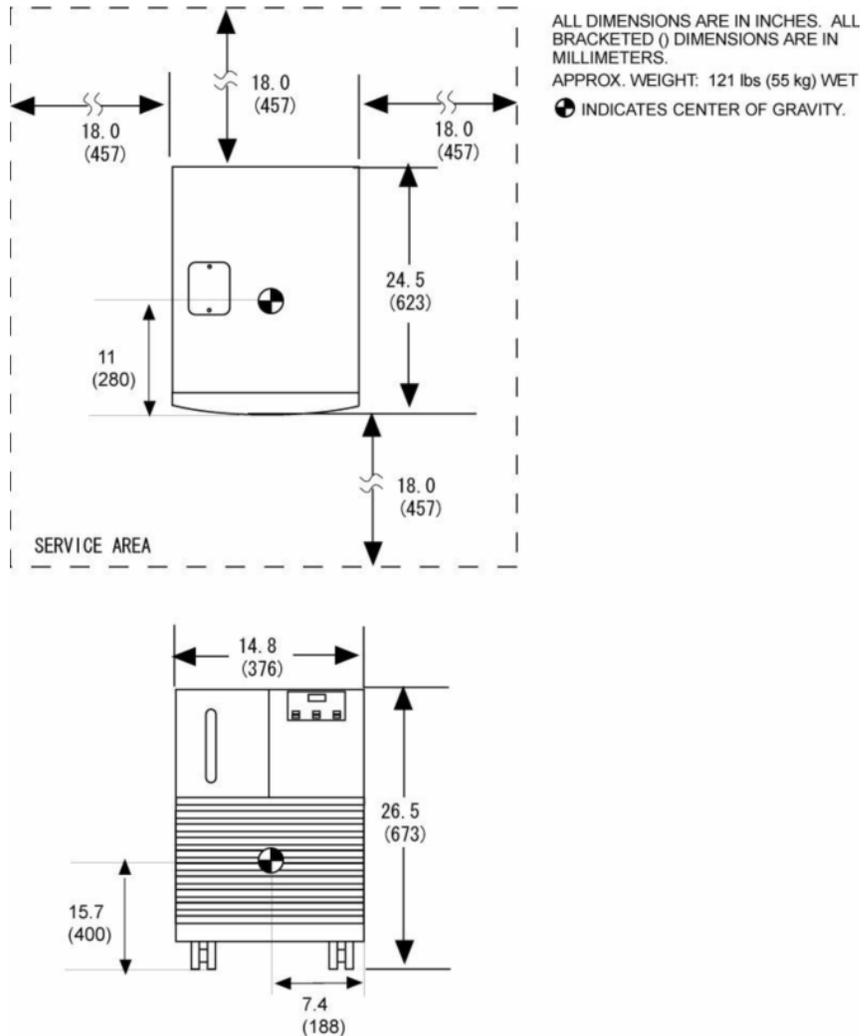
12.8 Water Chiller For System Cabinet - LCS (WC2) For Type A



NOTICE

Keep 18 inches (457mm) from at least two sides of water chiller for Air flow.

Illustration 3-41: Water Chiller (WC2) For System Cabinet



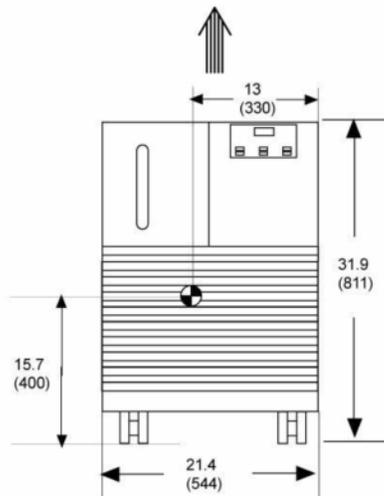
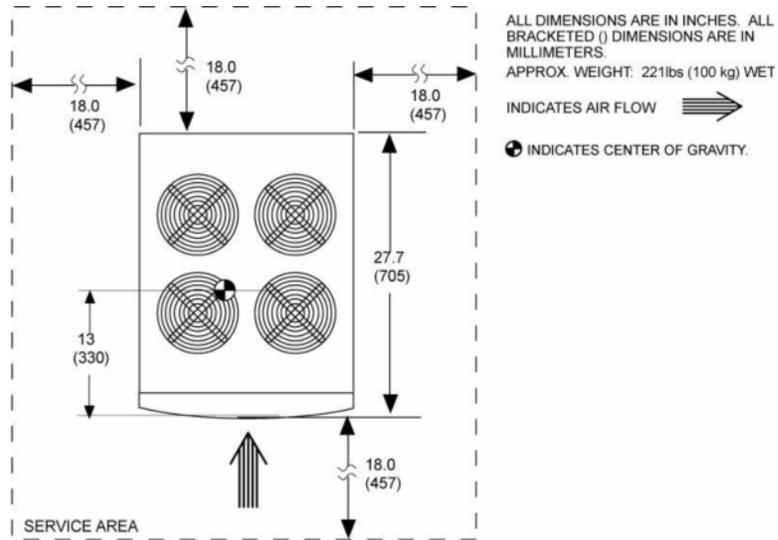
12.9 Water Chiller For System Cabinet - MCS (WC2) for Type B



NOTICE

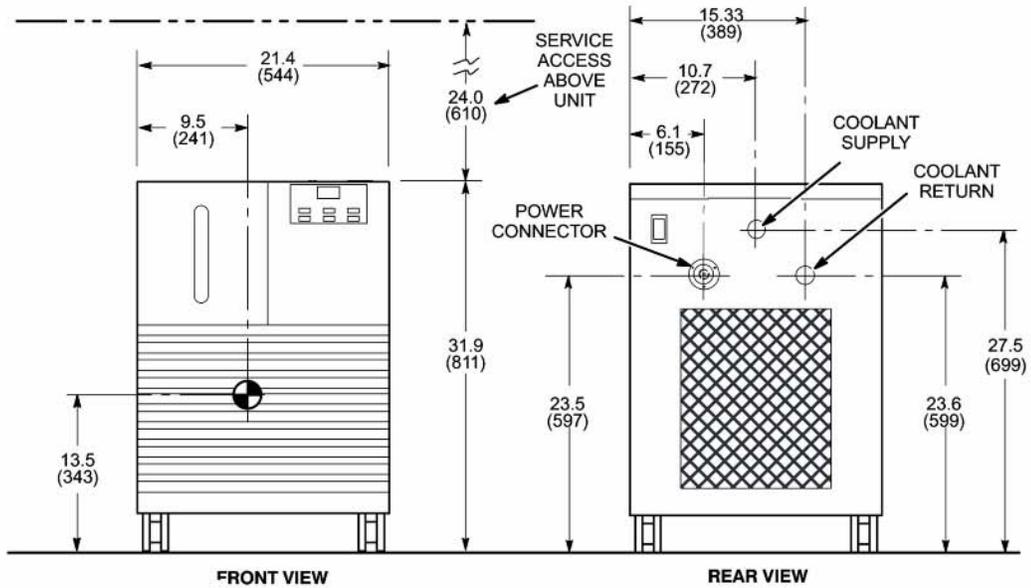
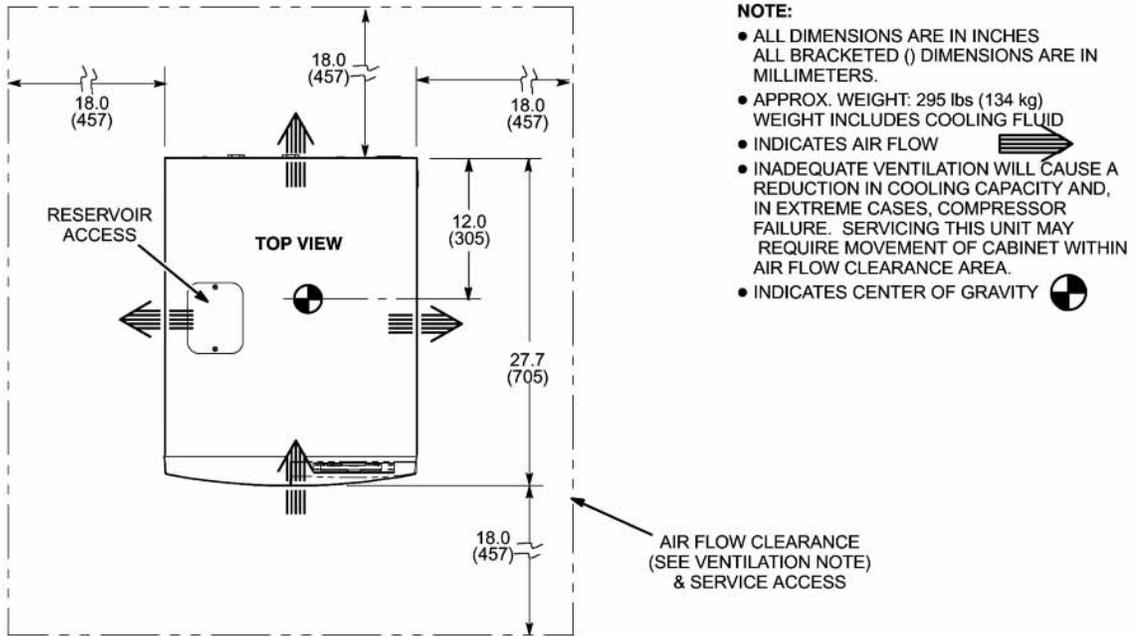
Keep 18 inches (457mm) from at least two sides of water chiller for Air flow.

Illustration 3-42: Water Chiller (WC2) For System Cabinet



12.10 Water Chiller For BRM Gradient Coil (WC1) for TypeB

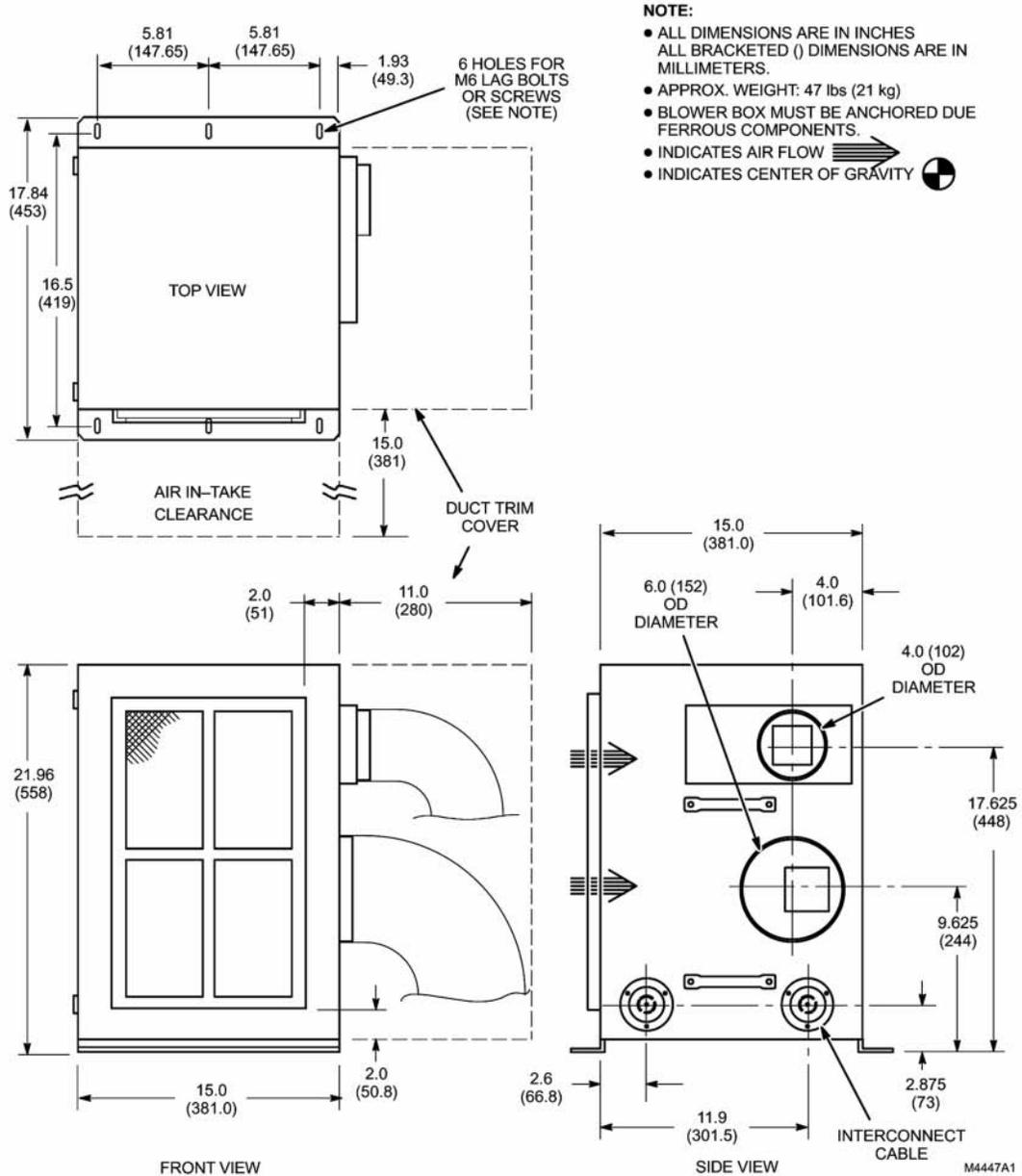
Illustration 3-43: Water Chiller (WC1) For BRM Gradient Coil Cooling Water



12.11 Blower Box

Magnetic Field Limit: 200 Gauss (20 mT)

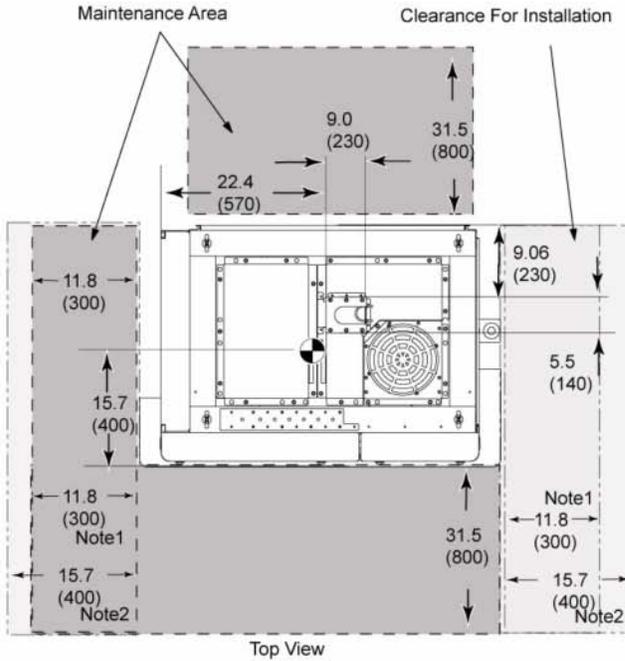
Illustration 3-44: Blower Box (MG6)



12.12 System Cabinet

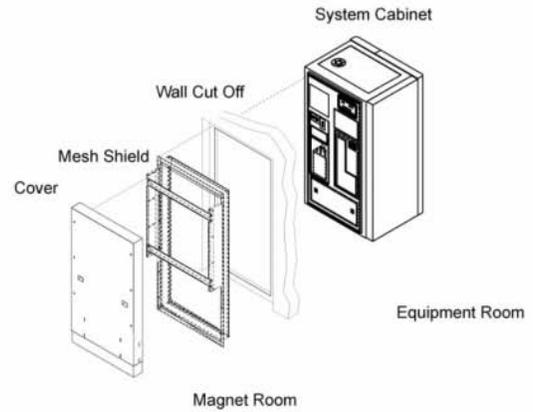
Refer to [System Cabinet and Penetration Panel](#) for special consideration of System Cabinet.

Illustration 3-45: System Cabinet



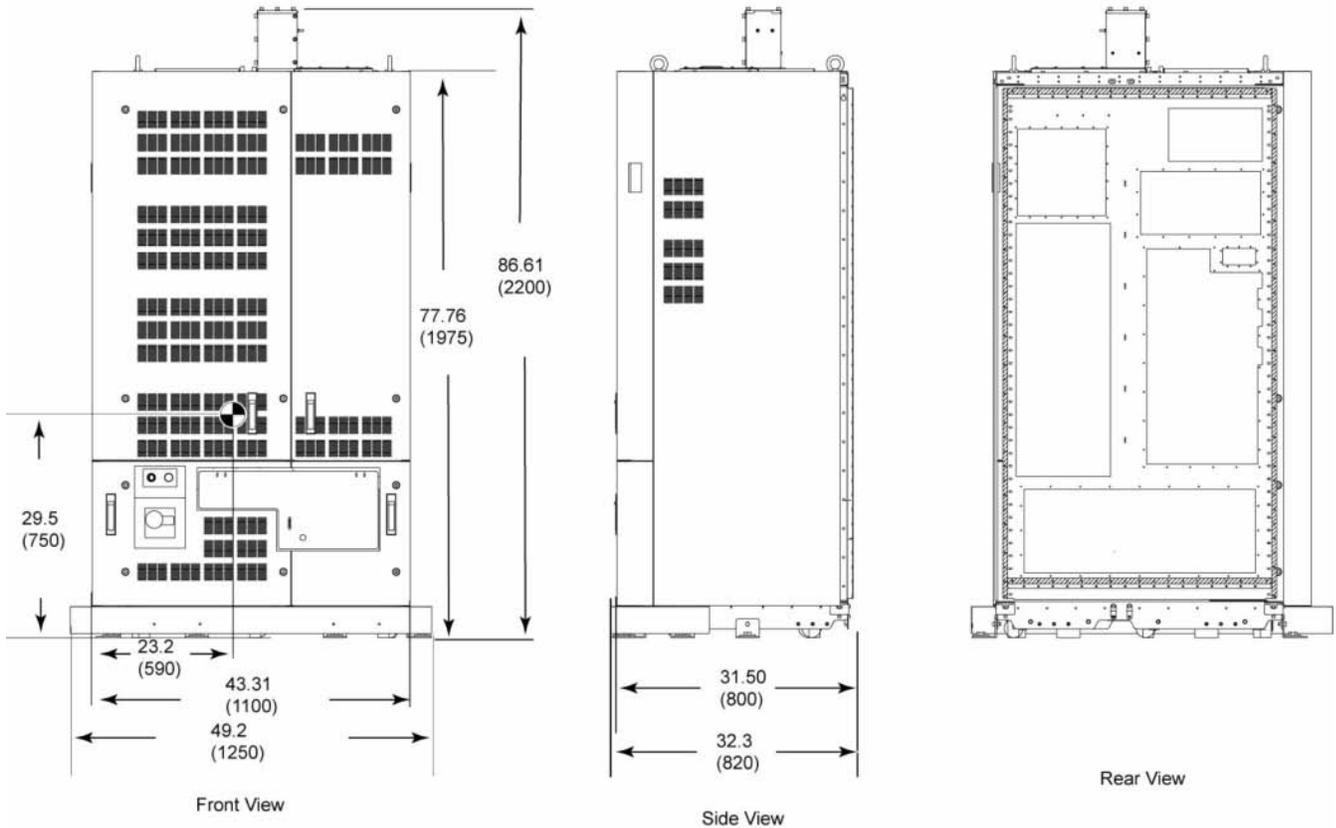
- NOTE**
- ALL DIMENSIONS ARE IN INCHES. ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.
 - APPROX. WEIGHT: 2205 lbs (1000kg)
 - INDICATE CENTER OF GRAVITY

Relationship of System Cabinet, RF shield wall, Mesh Shield, and cover.



Note1: During Installation, this clearance is necessary for non-seismic area or for seismic area (1st floor or lower)

Note2: During Installation, this clearance is necessary for Seismic Area and 2nd Floor or higher.

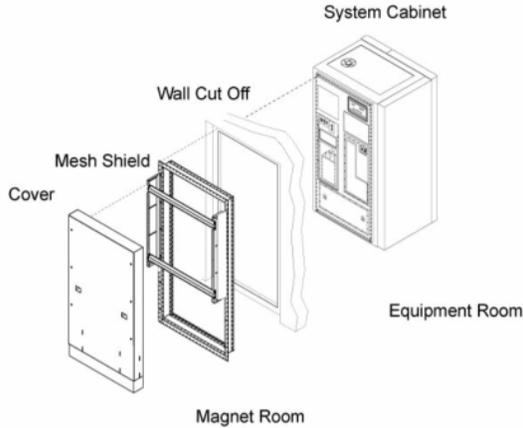


12.13 Mesh Shield and System Cabinet Cover

Refer to [System Cabinet and Penetration Panel](#) for special consideration of Mesh Shield and System Cabinet Cover.

Illustration 3-46: Mesh Shield and System Cabinet Cover

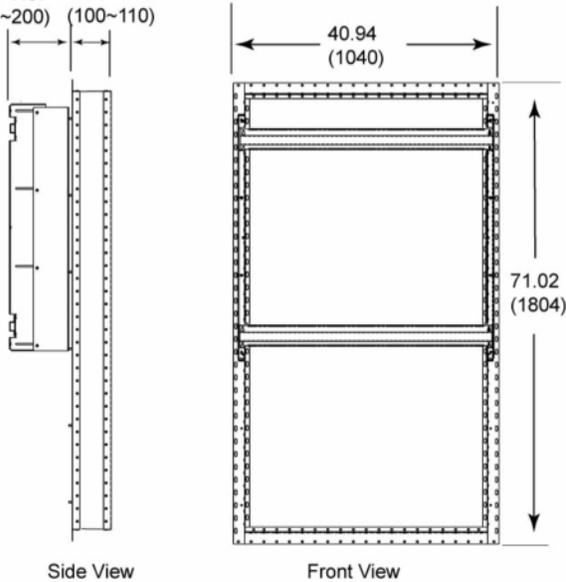
Relationship of System Cabinet, RF shield wall, Mesh Shield, and cover.



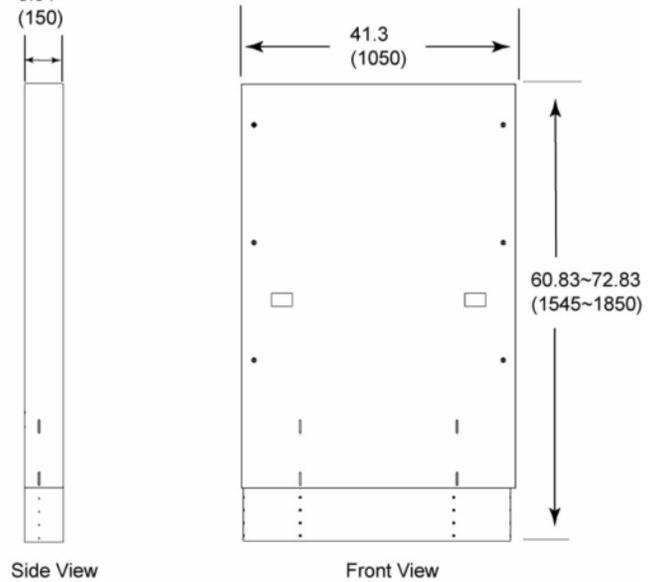
NOTE

- ALL DIMENSIONS ARE IN INCHES.
ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.

MESH SHIELD
3.94~7.87 (100~200)
3.94~4.33 (100~110)



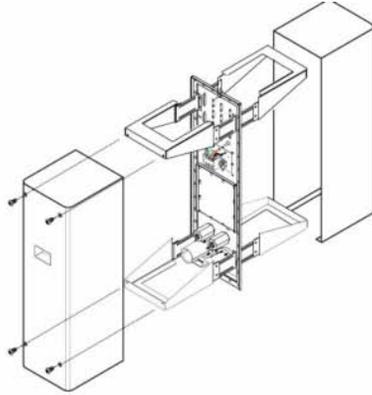
COVER
5.91 (150)



12.14 Penetration Panel

Refer to [System Cabinet and Penetration Panel](#) for the special consideration of penetration panel.

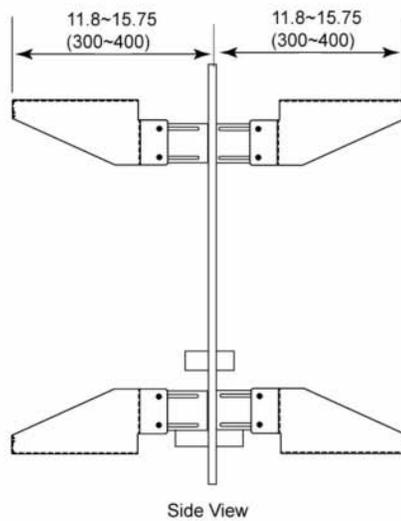
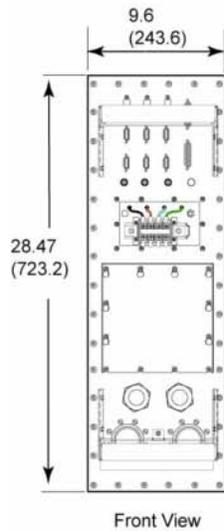
Illustration 3-47: Penetration Panel



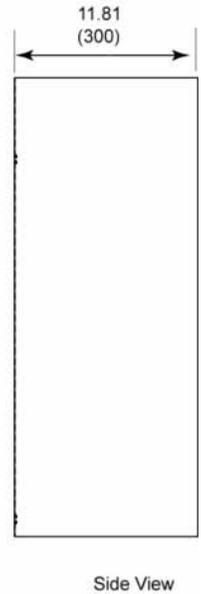
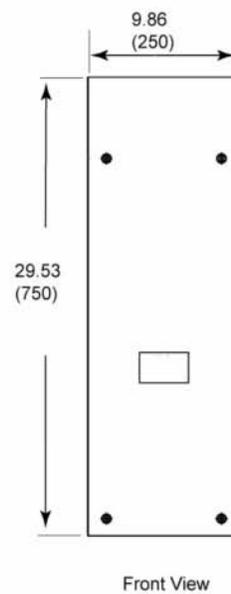
NOTE

- ALL DIMENSIONS ARE IN INCHES.
 ALL BRACKETED () DIMENSIONS
 ARE IN MILLIMETERS.

Penetration Panel



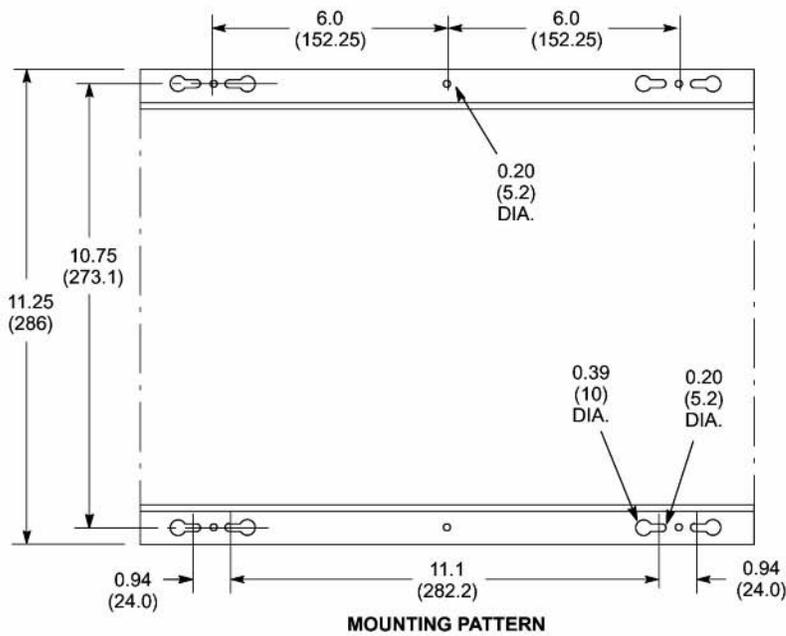
Cover



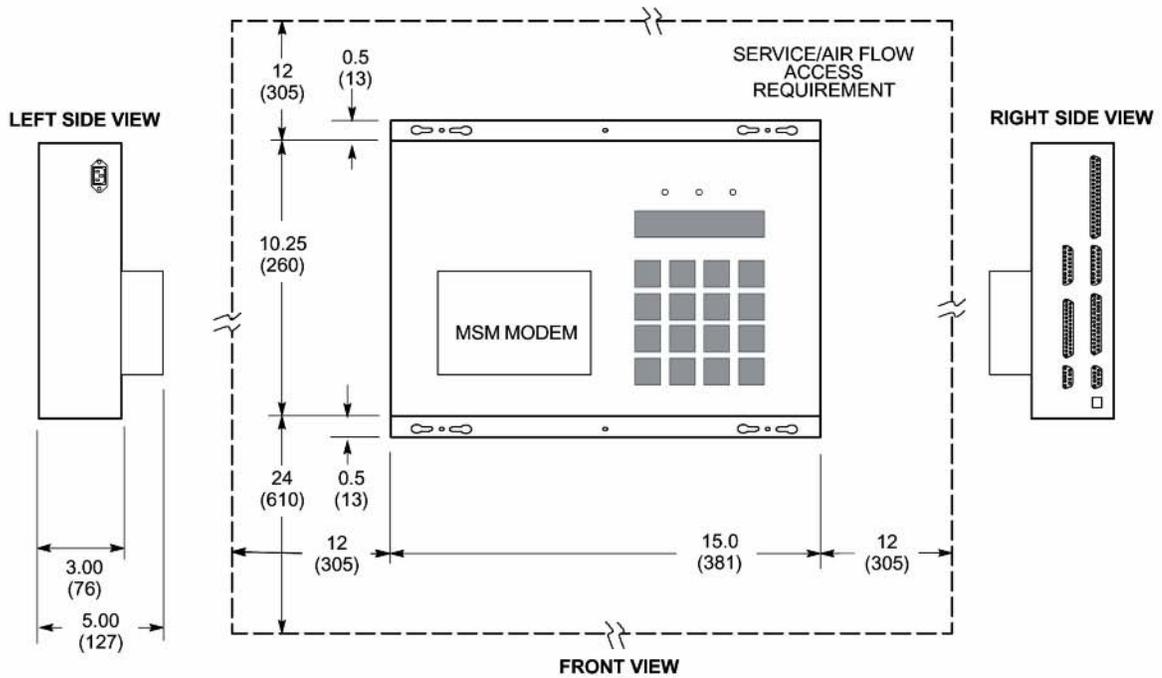
12.15 Magnet Monitor

Magnetic Field Limit: 50 Gauss (5 mT)

Illustration 3-48: Magnet Monitor (MSM1)



- NOTE:**
- ALL DIMENSIONS ARE IN INCHES
 ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.
 - APPROX. WEIGHT: 22 lbs (10 kg)



12.16 Patient Transport Table

NOTE: *: Patient Transport Table is selectable in Asia Pole.

Illustration 3-49: Patient Transport Table (Lite Table) for Asia*

NOTE:
 ALL DIMENSIONS ARE IN INCHES.
 ALL BRACKETED () DIMENSIONS
 ARE IN MILLIMETERS.
 WEIGHT: 330 lbs (150 kg)

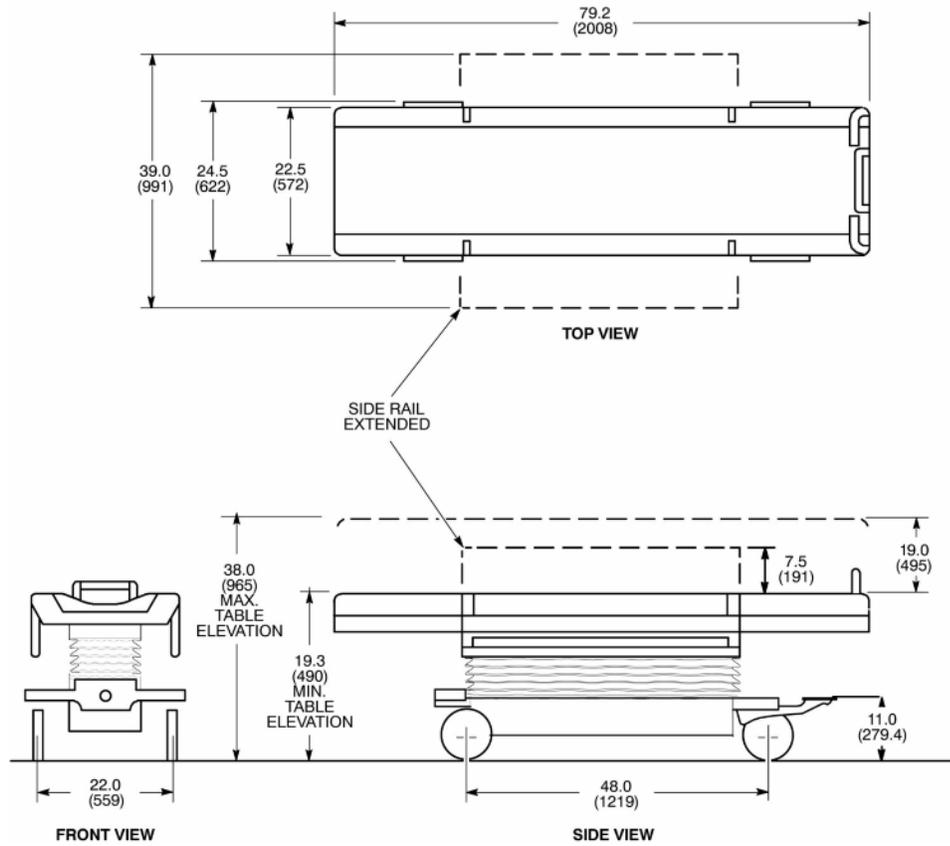
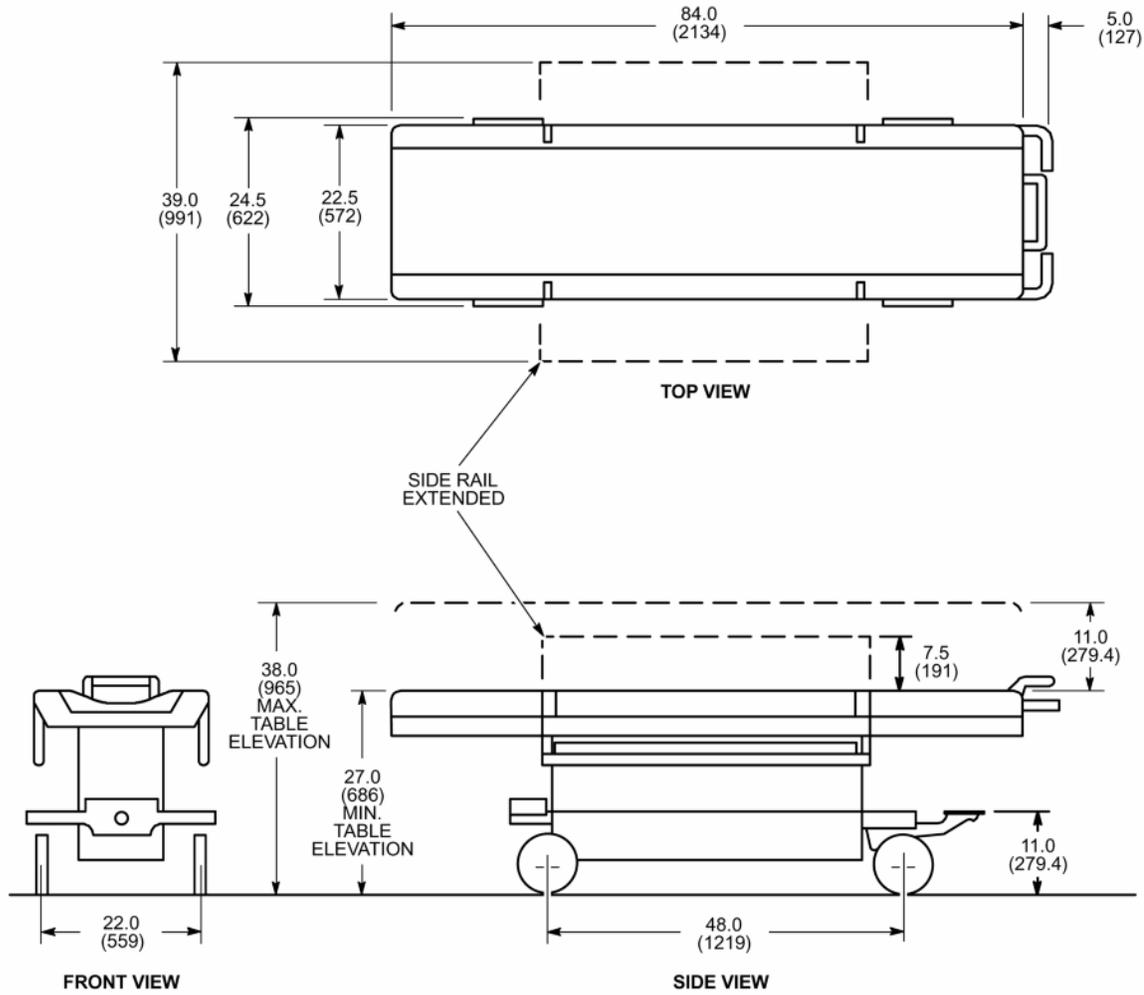


Illustration 3-50: Patient Transport Table for Americas, Europe, and Asia*

NOTE:

- ALL DIMENSIONS ARE IN INCHES
ALL BRACKETED () DIMENSIONS
ARE IN MILLIMETERS.
- APPROX. WEIGHT: 280 lbs (127 kg)
630 lbs (286 kg) WITH 350 lbs (159 kg)
PATIENT



12.17 Operator Workspace

Table 3-24: Operator Workspace List of Illustrations

Illustration Name	Illustration Number
Operator Workspace (OW1) Overall Dimensions	Illustration 3-51
GOC Computer Cabinet (OW1 A2)	Illustration 3-52
Operator Workspace Components Position on Table Top - Host LCD	Illustration 3-53
Operator Workspace Components Position on Table Top - SCSI Tower and 15 Inch LCD	Illustration 3-54
Operator Workspace Components Position on Table Top - Keyboard	Illustration 3-55

Illustration 3-51: Operator Workspace (OW1) Overall Dimensions

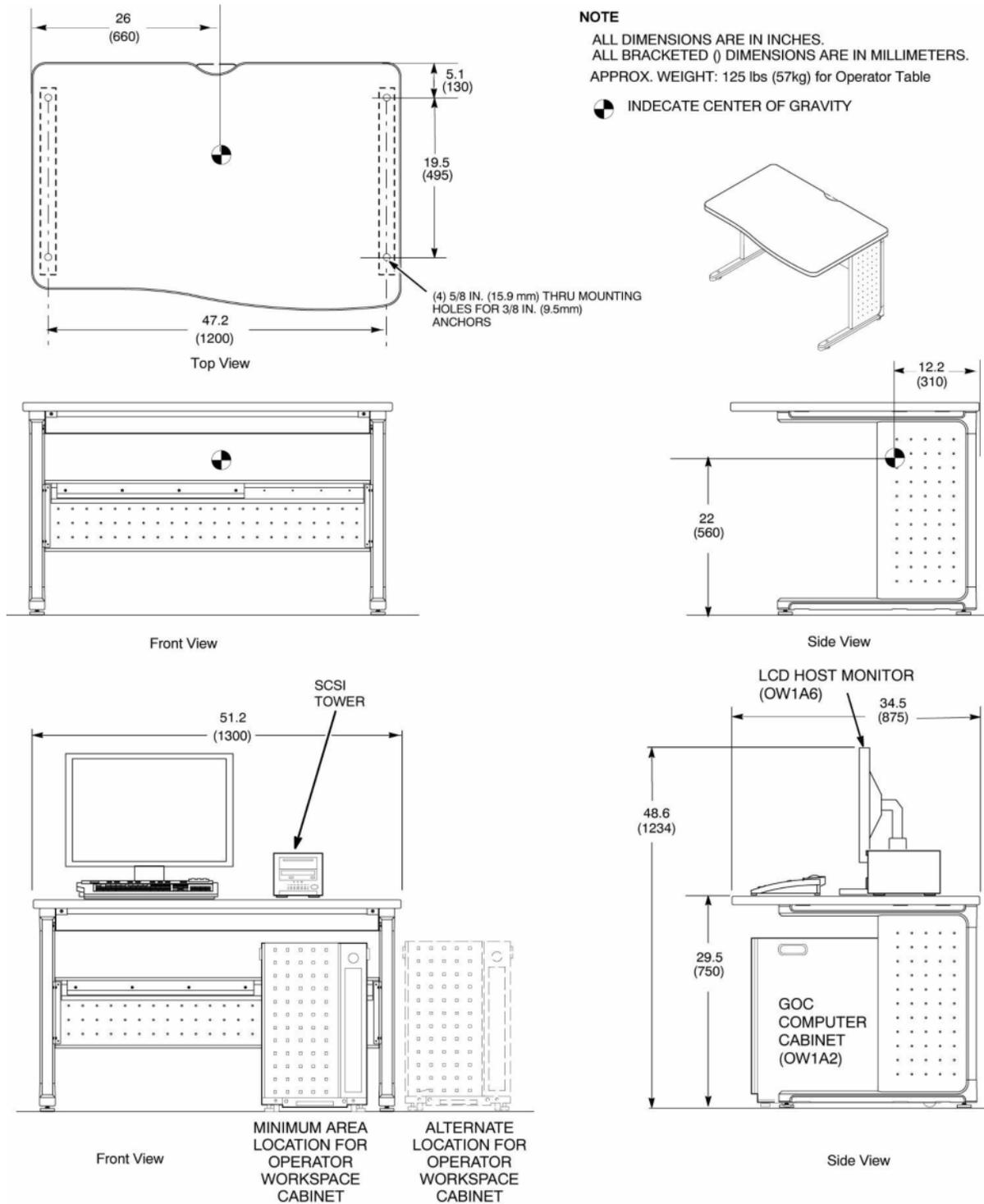


Illustration 3-52: GOC Computer Cabinet (OW1 A2)

NOTE:

- ALL DIMENSIONS ARE IN INCHES. ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.
- APPROX. WEIGHT: 144 lbs (65 kg)
- INDICATES AIR FLOW 
- INDICATES CENTER OF GRAVITY. 

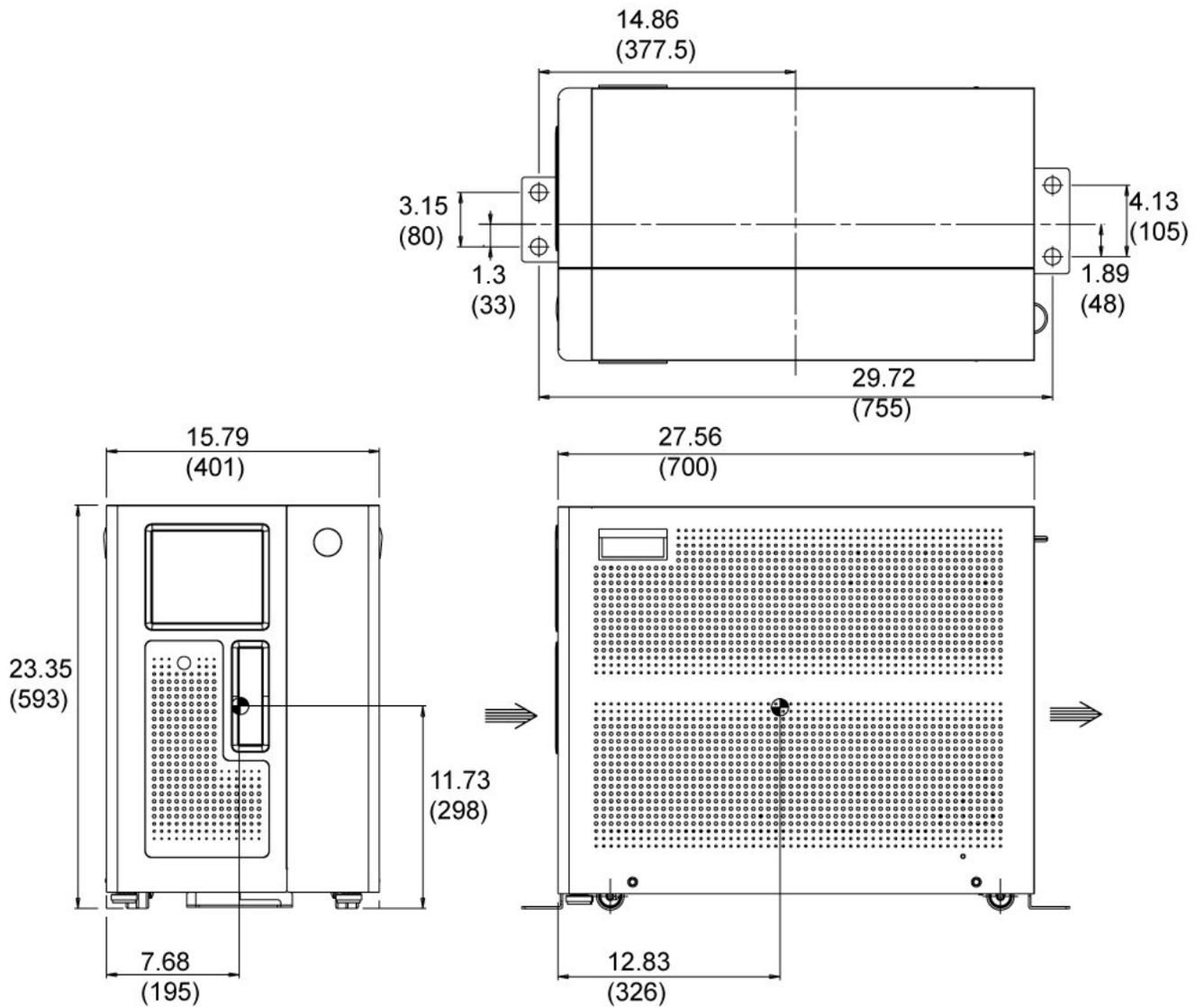


Illustration 3-53: Operator Workspace Components Position on Table Top - Host LCD

NOTE:

- ALL DIMENSIONS ARE IN INCHES
 ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.
- APPROX. WEIGHT – WITH STAND: 19.8 lbs (9 kg)
 APPROX. WEIGHT – WITHOUT STAND: 13.2lbs (6 kg)

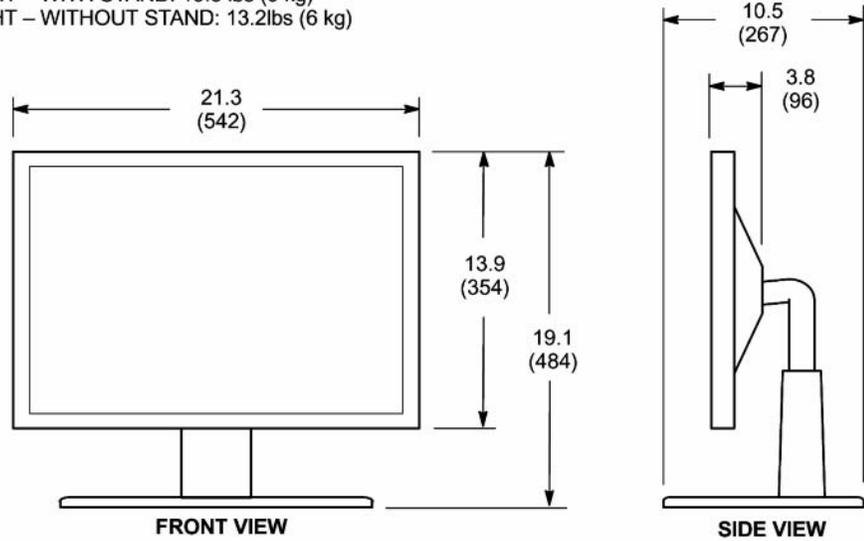
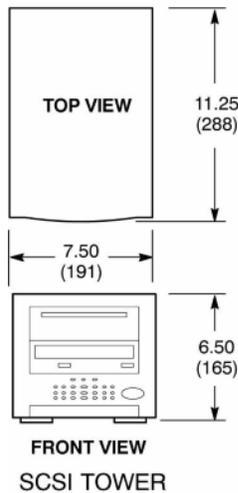


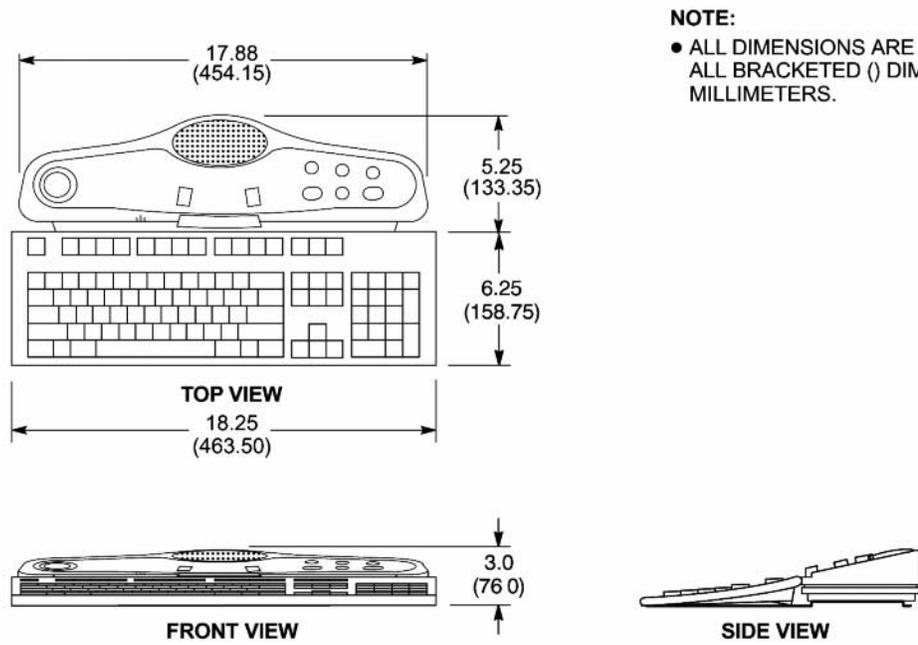
Illustration 3-54: Operator Workspace Components Position on Table Top - SCSI Tower



NOTE:

- ALL DIMENSIONS ARE IN INCHES
- ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.
- INDICATES AIR FLOW

Illustration 3-55: Operator Workspace Components Position on Table Top - Keyboard



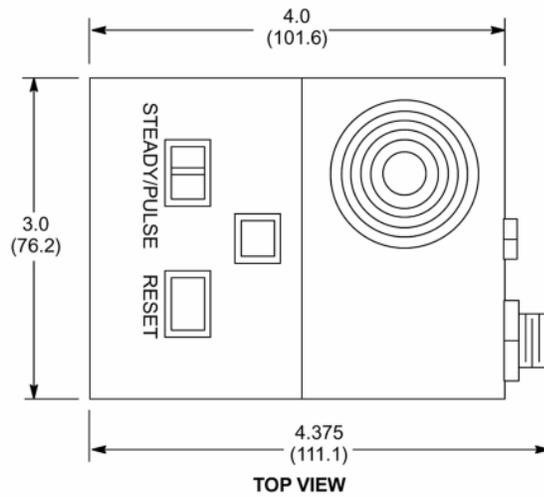
NOTE:

- ALL DIMENSIONS ARE IN INCHES
- ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.

12.18 Pneumatic Patient Alert

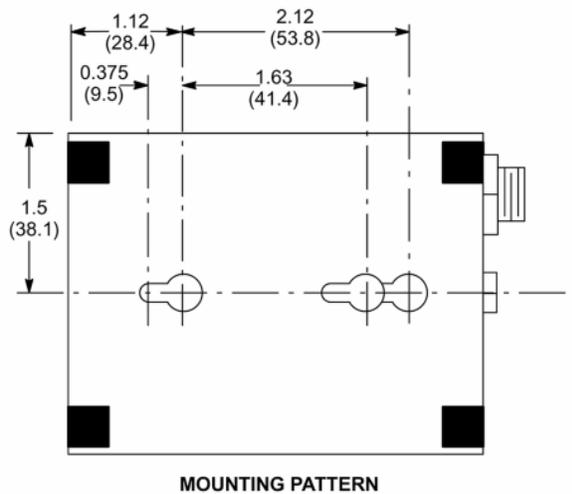
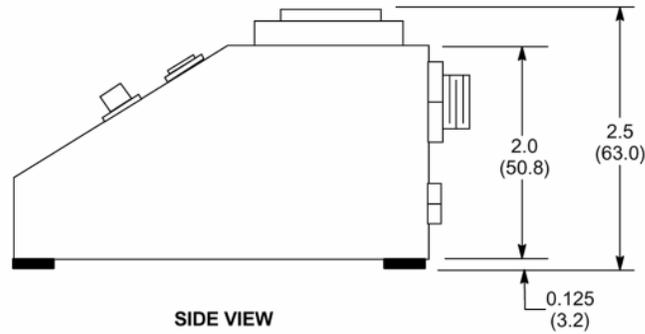
Magnetic Field Limit: 100 Gauss (10 mT)

Illustration 3-56: Pneumatic Patient Alert Control Box (PA1)



NOTE:

- ALL DIMENSIONS ARE IN INCHES. ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.
- APPROX. WEIGHT: 0.5 lbs (0.2 kg)

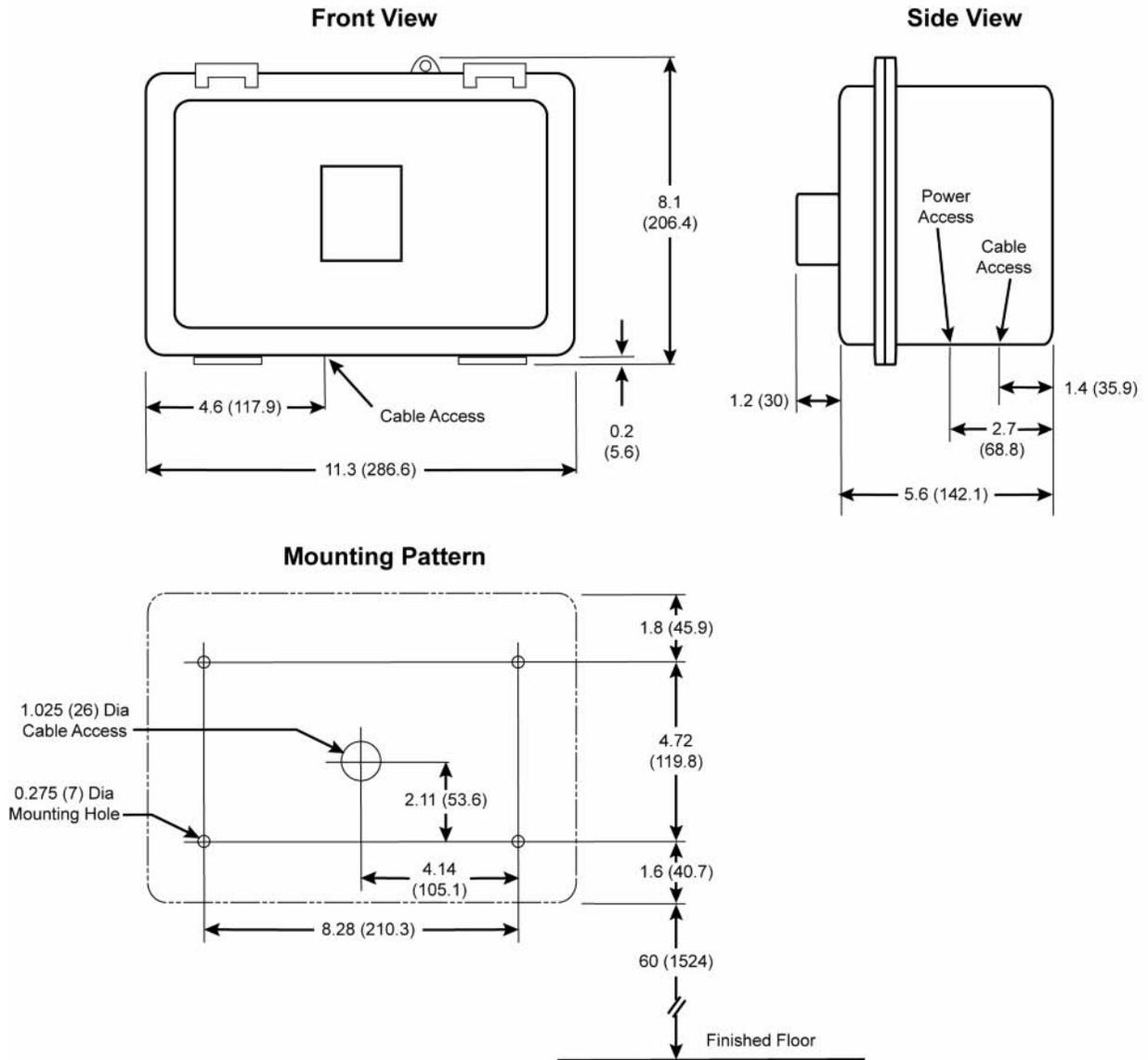


12.19 Magnet Rundown Unit

1. Magnetic Field Limit: 200 Gauss (20 mT)
2. Weight: 7 lbs (3.2 kg)

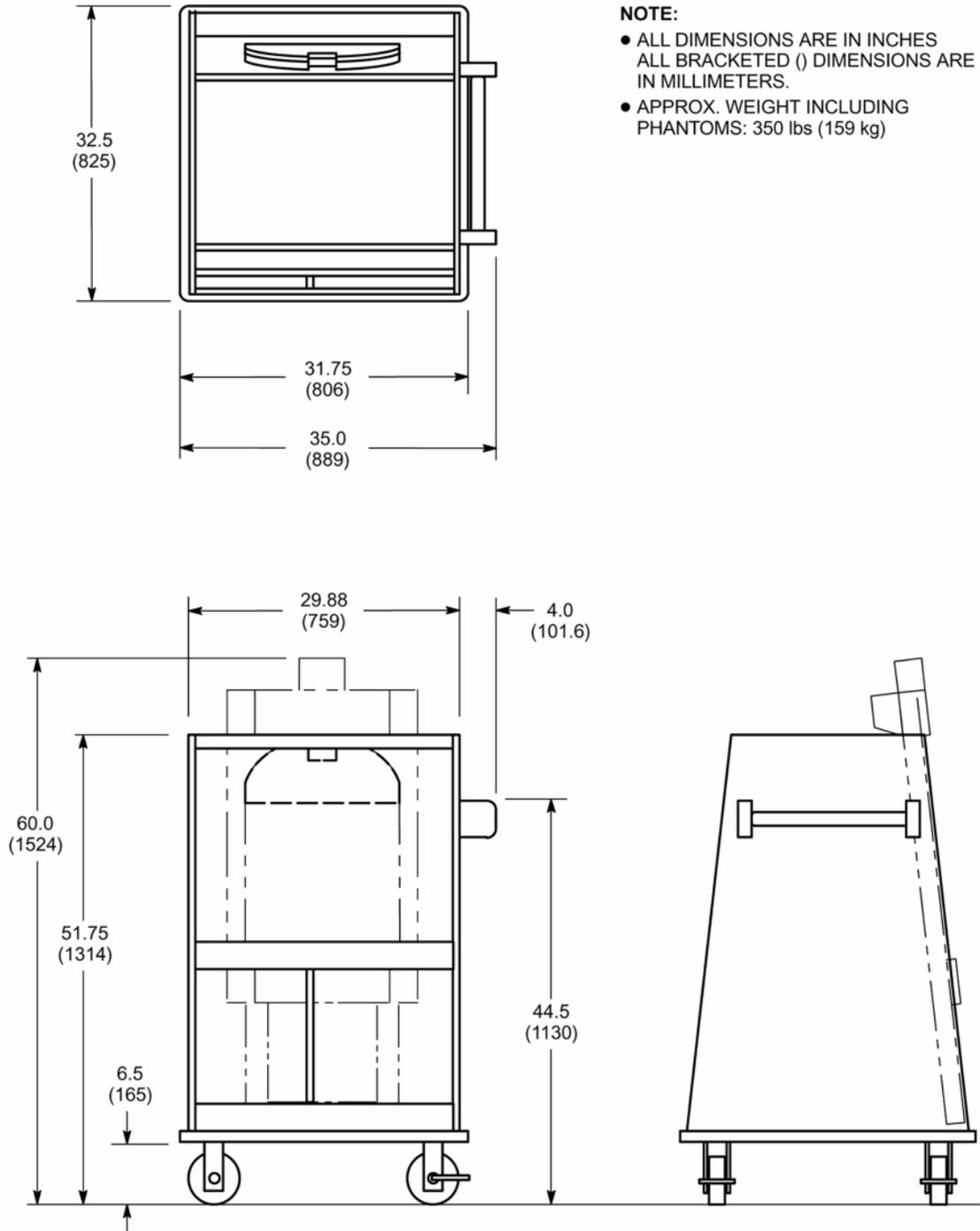
Illustration 3-57: Magnet Rundown Unit (MS4)

Magnet Rundown Unit (MRU)
 All Dimensions are in inches
 Bracketed dimensions are in millimeters



12.20 SPT Phantom Set Shipping/Storage Cart

Illustration 3-58: SPT Phantom Set Shipping/Storage Cart

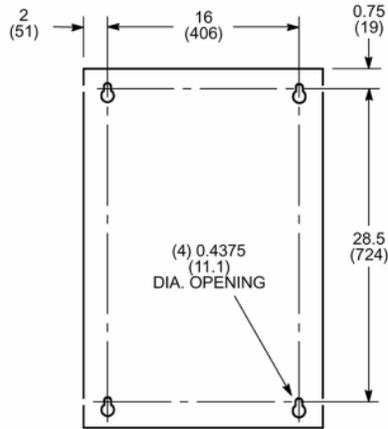


12.21 DC Lighting Controller Option

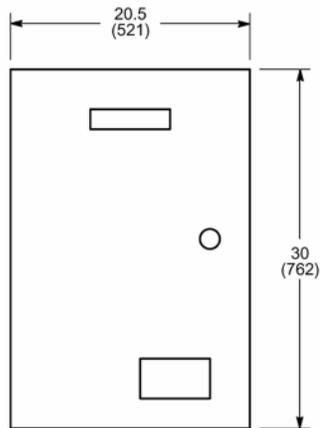
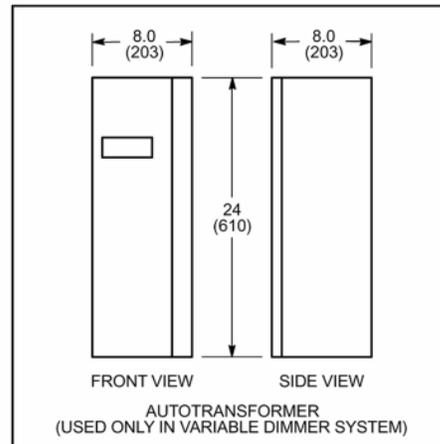
Illustration 3-59: DC Lighting Controller Option

NOTE:

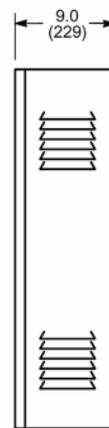
- ALL DIMENSIONS ARE IN INCHES. ALL BRACKETED () DIMENSIONS ARE IN MILLIMETERS.
- APPROX. WEIGHTS:
 CONTROL PANEL: 155 lbs (70 kg)
 AUTOTRANSFORMER: 60 lbs (27 kg)



MOUNTING PATTERN
 (CONTROL PANEL)



FRONT VIEW
 (CONTROL PANEL)



SIDE VIEW
 (CONTROL PANEL)

12.22 Oxygen Monitor Option

1. Oxygen Monitor: Magnetic Field Limit: 100 Gauss (10 mT)
2. Remote Oxygen Monitor Sensor: Magnetic Field Limit: 200 Gauss (20 mT)

Illustration 3-60: Oxygen Monitor (OM1)

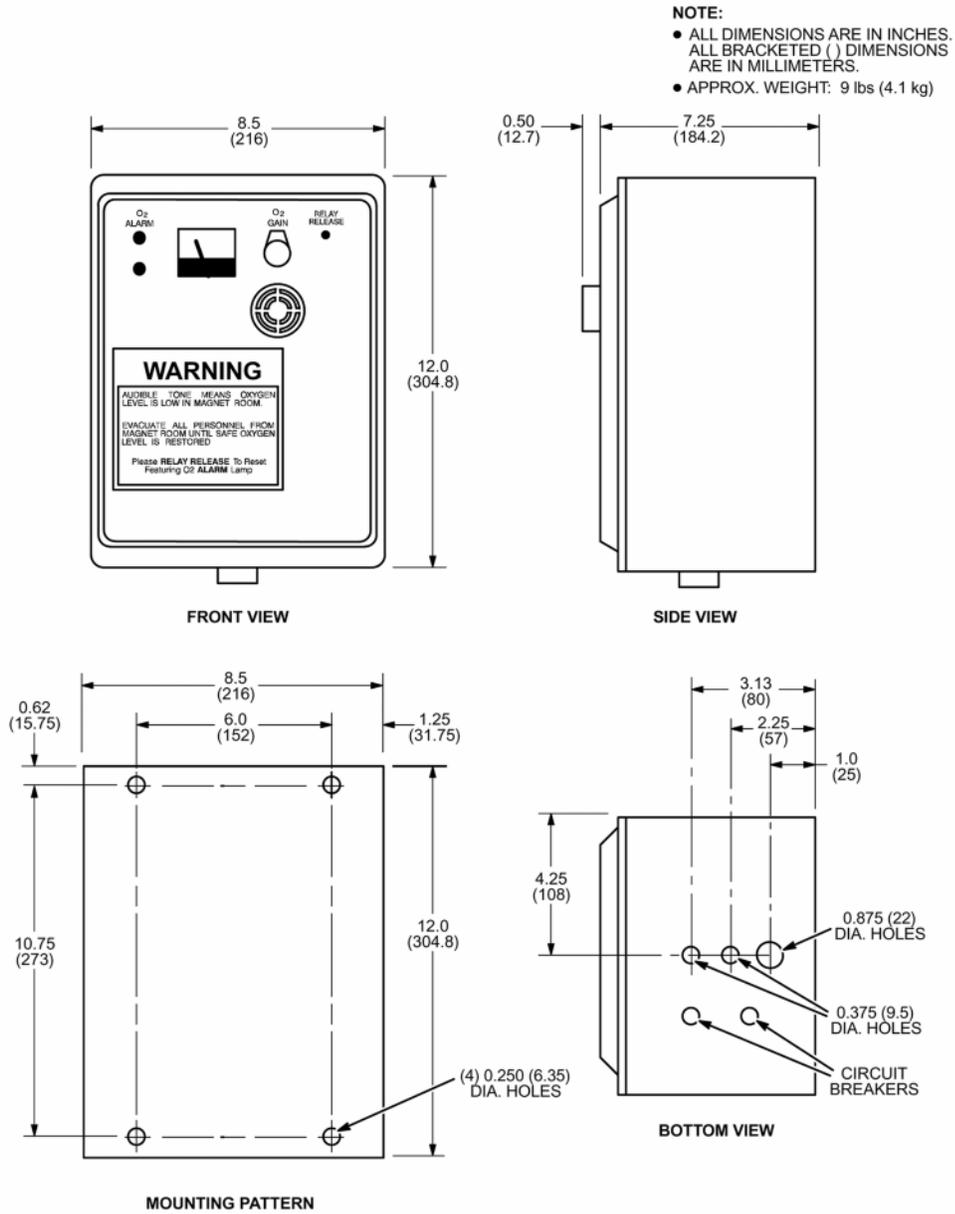
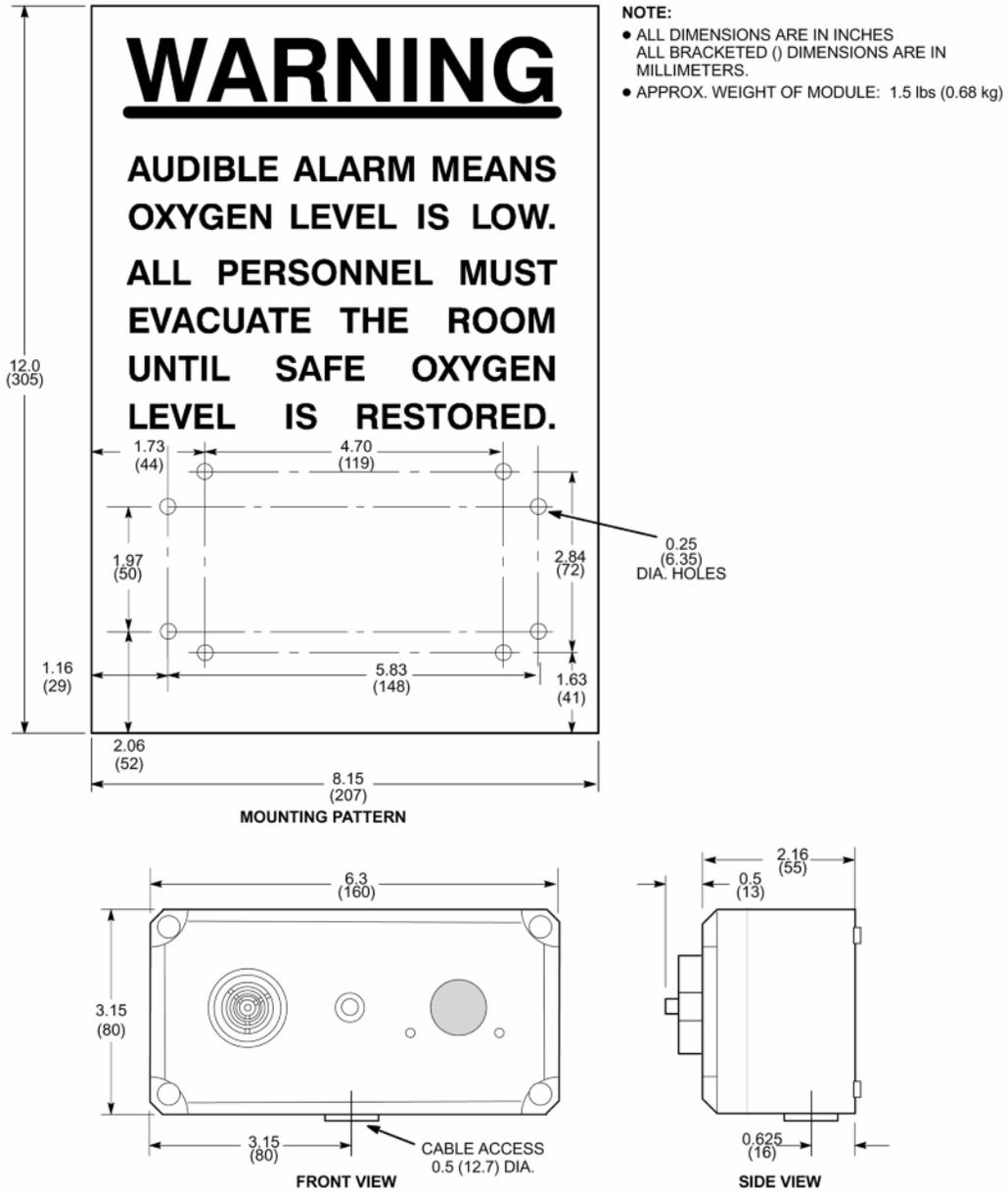


Illustration 3-61: Remote Oxygen Sensor Module (OM3)



Chapter 4 Magnetic Field Consideration

1 Introduction

The static magnetic field is three-dimensional and extends into space above and below the magnet as well as to the surrounding space on the same level. Objects within this three-dimensional space can be affected by the magnetic field or can affect the magnetic field, refer to [Chapter 3, Proximity Limits](#). Therefore all ferromagnetic material within this three-dimensional magnetic field must be thoroughly examined to ensure it is not significantly affected by nor affects the magnetic field.

2 Impact of Structural Steel

Structural steel, within the static magnetic field of a magnet, has a definite impact on the homogeneity or uniformity of the field. The magnet's field homogeneity is an important criteria that impacts both image quality and chemical shift analysis (spectroscopy).

3 Structural Steel Evaluation Of Proposed Sites



NOTICE

If a site has an existing magnetic shield then the existing shield must be evaluated by the GE Healthcare MR Siting And Shielding Group.

Excessive steel, including structural steel, will degrade the homogeneity of the magnet and the system performance. Refer to [Chapter 5, Magnet Room Floors Magnetic Properties](#) under Construction Materials in Site Environment chapter. An evaluation of the effects of structural steel on the magnet is required in some instances.

The customer must provide information indicating mass and location of all iron and steel within an 8 feet (2.5 meter) radius of the 1.5T LCC Magnet isocenter. This 8 feet (2.5 meter) radius is shown as the shaded region in the isogauss line plot illustrations in [Magnetic Field](#). This includes iron near the magnet such as sewer pipes, existing magnetic shielding, floor beams and any steel rebar in the concrete floor or structural members. Any structural steel required for the installation of the magnet at the particular site (i.e. floor reinforcement) must also be indicated.

4 Magnetic Shielding



NOTICE

If a site has an existing magnetic shield and an upgrade to the LCC magnet is being performed, the existing shield must be evaluated by the GE Healthcare MR Siting And Shielding Group.

Magnetic shielding is used to reduce the fringe field around the magnet. Refer to [Magnetic Field](#) for the fringe field plots for the Magnet.

Room magnetic shielding generally consists of iron plates in the room walls, floor, and ceiling. Special consideration should be given when selecting a magnet site location due to the expense and effort required to provide magnetic shielding.

Designing a magnetic shield requires a comprehensive computer analysis which predicts the effect the shield will have on the magnetic field as well as the effect of the shield on the homogeneity of the magnet. The structural capacity of the site and space availability are important factors in the design of the shield. The GE Healthcare MR Siting & Shielding Group has the capability to design magnetic shields which meet a broad range of site requirements.

5 Magnetic Field

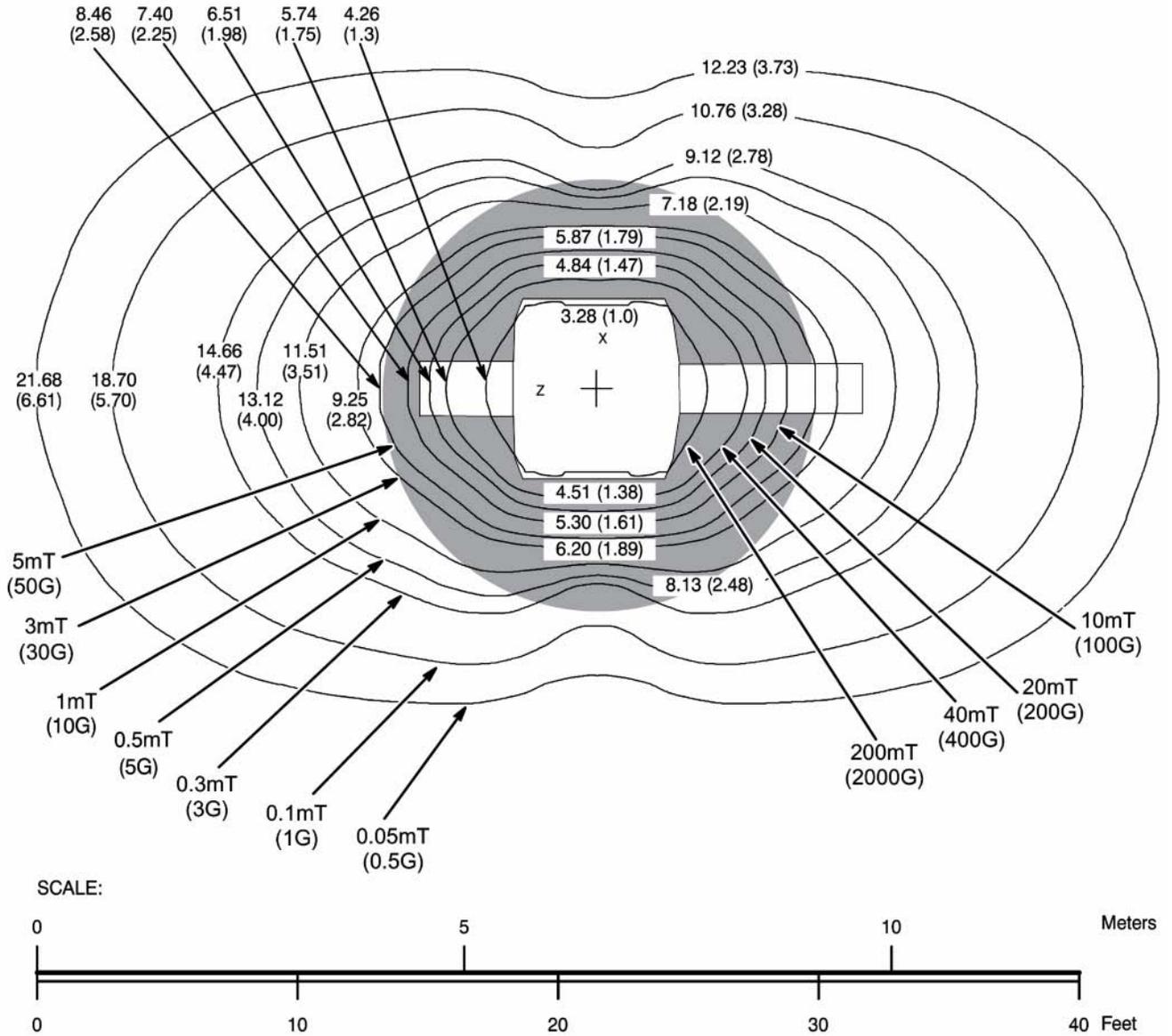
5.1 Fringe Field

[Illustration 4-1](#), [Illustration 4-2](#), and [Illustration 4-3](#) are the fringe field plots for the 1.5T LCC Magnet. These plots illustrate the three-dimensional area of magnetic field without the influence of any nearby ferrous objects or the earth's ambient magnetic field. Actual magnetic field intensity at given locations will vary from these plots due to the following effects:

- Ferrous materials used in building construction which will become permanently magnetized when in close proximity to the MR generated magnetic field.
- Earth's magnetic field - about 0.5 gauss in strength and unidirectional.

Therefore, these plots are only approximations of actual field intensities found at points surrounding the magnet. These plots should be used as an aid in reviewing the location of MR and hospital equipment and services (i.e. elevators, vehicular traffic, computer monitors, etc.). Refer to [Chapter 3, Proximity Limits](#) for the sensitivities of various equipment within the magnetic field.

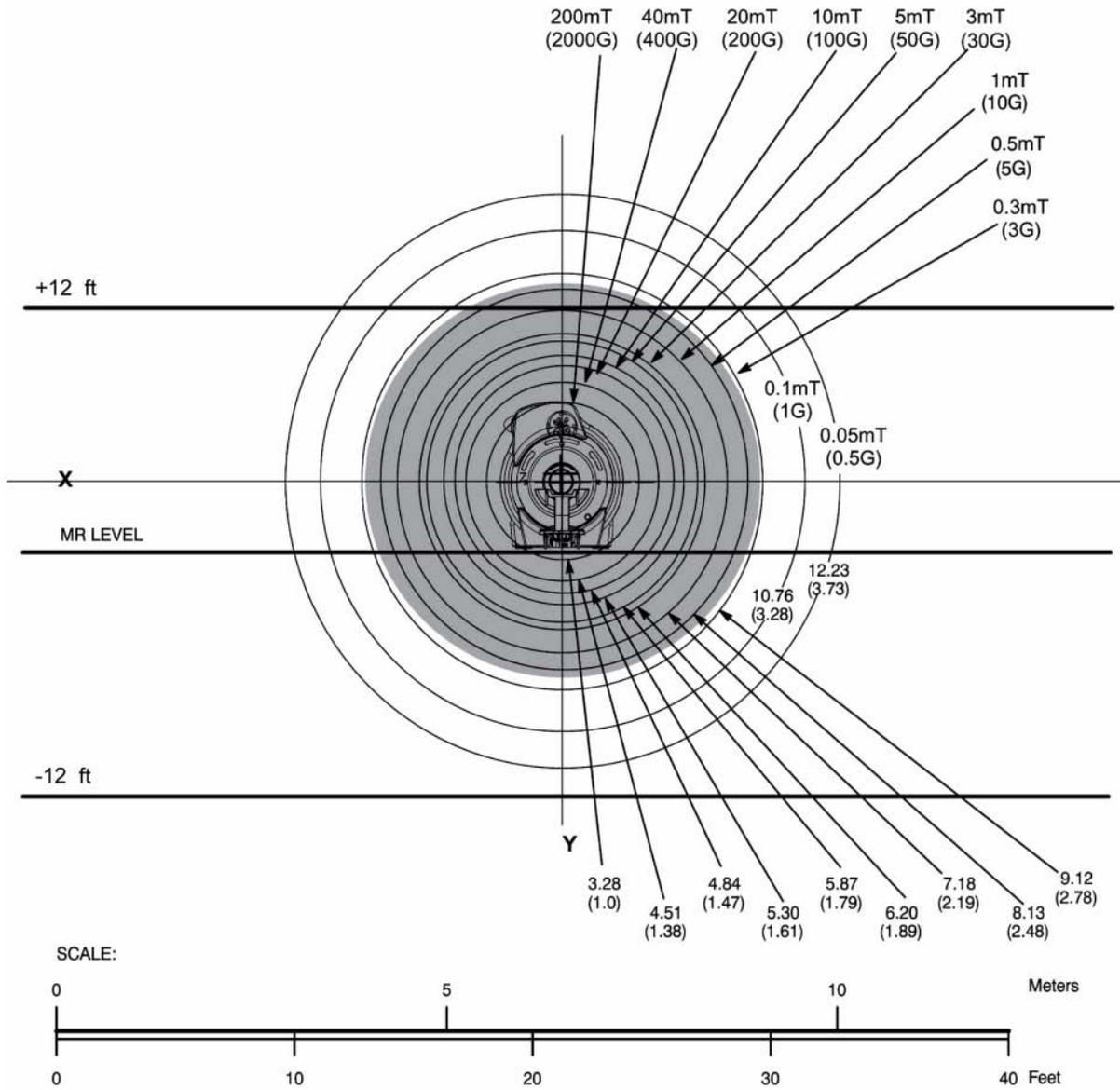
Illustration 4-1: 1.5 Tesla LCC Magnetic Isogauss Line Plot - Top View



NOTE:

- MEASURED MAGNETIC FLUX DENSITY WILL VARY FROM PLOT DUE TO FACTORS SUCH AS CONCENTRATING EFFECTS OF NEARBY FERROUS OBJECTS AND AMBIENT FIELDS, INCLUDING EARTH'S MAGNETIC FIELD.
- POTENTIAL EXISTS UNDER FAULT CONDITIONS THAT THE 5 GAUSS LINE MAY EXPAND TO 16.40 ft (5.0 m) RADIALLY AND 22.96 ft (7.0 m) AXIALLY FOR 2 SECONDS OR LESS.

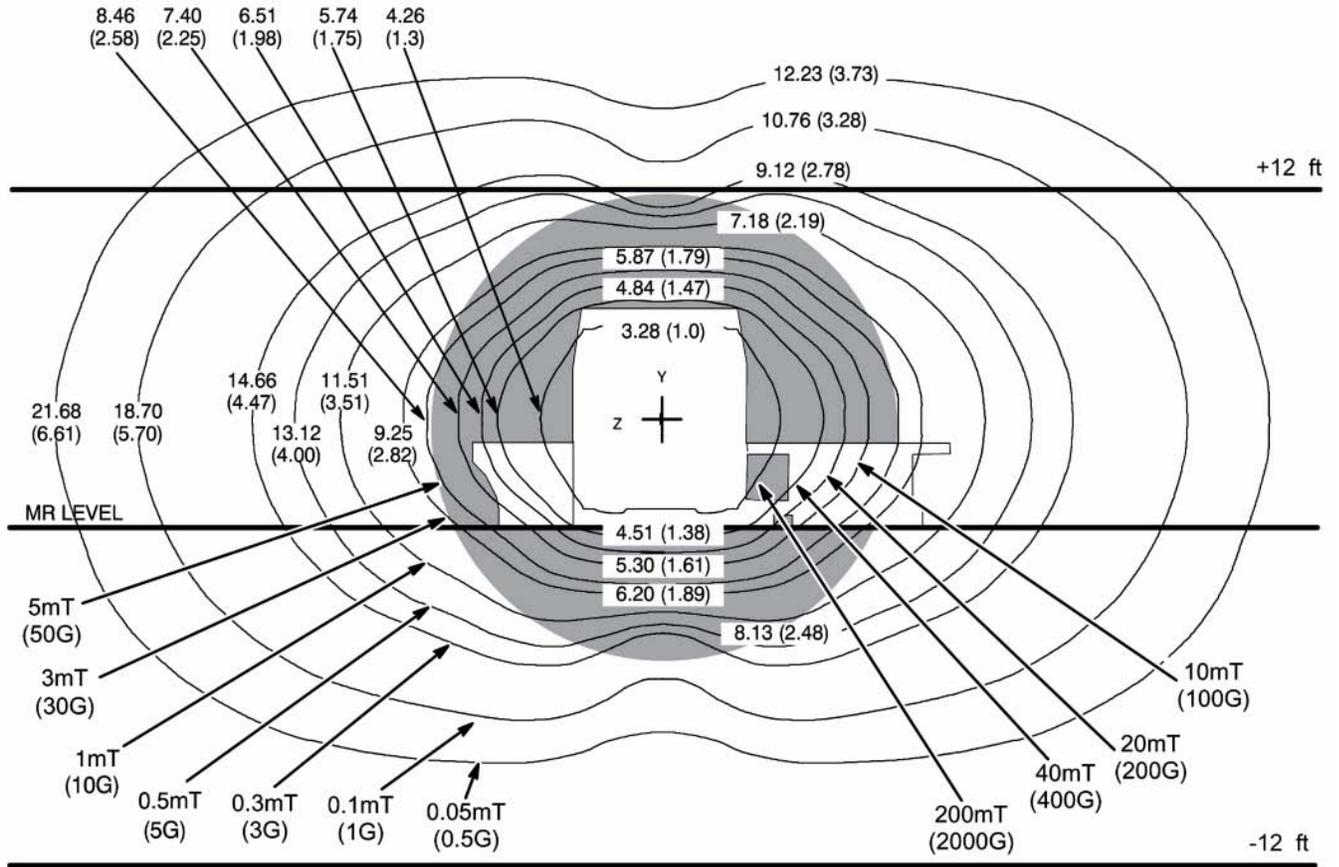
Illustration 4-2: 1.5 Tesla LCC Magnetic Isogauss Line Plot - Front View



NOTE:

- MEASURED MAGNETIC FLUX DENSITY WILL VARY FROM PLOT DUE TO FACTORS SUCH AS CONCENTRATING EFFECTS OF NEARBY FERROUS OBJECTS AND AMBIENT FIELDS, INCLUDING EARTH'S MAGNETIC FIELD.
- POTENTIAL EXISTS UNDER FAULT CONDITIONS THAT THE 5 GAUSS LINE MAY EXPAND TO 16.40 ft (5.0 m) RADIALLY FOR 2 SECONDS OR LESS.

Illustration 4-3: 1.5 Tesla LCC Magnetic Isogauss Line Plot - Side View



SCALE:



NOTE:

- 12 ft (3.66 m) BETWEEN FLOORS.
- MEASURED MAGNETIC FLUX DENSITY WILL VARY FROM PLOT DUE TO FACTORS SUCH AS CONCENTRATING EFFECTS OF NEARBY FERROUS OBJECTS AND AMBIENT FIELDS, INCLUDING EARTH'S MAGNETIC FIELD.
- POTENTIAL EXISTS UNDER FAULT CONDITIONS THAT THE 5 GAUSS LINE MAY EXPAND TO 16.40 ft (5.0 m) RADIALLY AND 22.96 ft (7.0 m) AXIALLY FOR 2 SECONDS OR LESS.

6 Exclusion Zone

The 5 gauss exclusion zone for cardiac pacemakers, neurostimulators, and other biostimulation devices is shown in isogauss line plot illustrations in [Magnetic Field](#) for 1.5T LCC Magnet. It should be noted the vertical views for the various magnetic field plots show 12 ft (3.66 m) between floors for reference. If the distance between floors is other than 12 ft (3.66 m), appropriate corrections must be made.

The interaction of the main magnet coils and the cancellation coils results in the effective shielding for the active shield magnet. Magnet quenches can actually cause a very short magnetic field transient resulting in the 5 gauss (0.5mT) field expanding for 2 seconds or less as noted in the isogauss line plot illustrations in [Magnetic Field](#) for 1.5T LCC (Active Shield) magnet.

It is recommended every site consider the event of a quench and plan accordingly (such as placing 5 gauss (0.5mT) warning signs at the expanded locations).

This page left intentionally blank.

Chapter 5 Site Environment

1 Introduction

The rating and duty cycles of all subsystems are applicable only if the room environment is maintained as specified in the following sections.



CAUTION

The MR system environment must be constantly maintained (i.e. holidays, weekends, etc.) to prevent exceeding the temperature and humidity specifications. Subjecting the equipment to consistent excessive temperatures and humidity above specifications may shorten the life of the internal electrical components.

2 IEC EMC Compliance

Per IEC 60601-1-2 Edition 2 Medical Electrical Equipment requires special precautions regarding Electromagnetic Compatibility (EMC) and must be installed and put into service according to the EMC information provided in the following tables. Full declaration is stored on-site in the user manual delivered with the system.

The MR system is designed and tested to the following standards:

Table 5-1: Guidance And Manufacturer’s Declaration – Electromagnetic Emissions

Emmissions Test	Type of Test	Compliance Level
CISPR 11	Conducted Emissions	Class A Group 2
	Radiated Emissions	Class A Group 2
IEC 61000-4-3	E-Field RF Immunity	80-2500 MHz, 5 V/m with AM 80% @ 1kHz or 2 Hz

Table 5-2: Guidance And Manufacturer’s Declaration – Electromagnetic Immunity

Immunity test	IEC 60601 test level	Compliance Level
Electrostatic discharge (ESD) IEC 61000-4-2	±8 kV air	Air 2, 4, 6, 8, 10kV
	±6 kV contact	Contact 2, 4, 6, 8kV
		Coupling Plane 2, 4, 6, 8kV
Electrical fast transient/burst IEC 61000-4-4	±2 kV for power supply lines	Power Lines 3kV
	±1 kV for input/output lines	Interconnect Cables 1.5kV
Surge IEC 61000-4-5	±2 kV common mode	Common Mode ±2 kV
	±1 kV differential mode	Differential ±1 kV
Power frequency(50/60Hz) magnetic field IEC 61000-4-8	3 A/m	4.5A/m at 50 Hz. and 60 Hz.
Voltage dips, shortinterruptions andvoltage variationson power supplyinput lines IEC 61000-4-11	<5 % UT (>95 % dip in UT) for 5 sec	5 sec @ >-95%, Each phase individually
Conducted RF IEC 61000-4-6	V1 = 3 Vrms 150 kHz to 80 MHz	0.15-80 MHz @5 VRMS with AM 80% @ 1kHz 1% Frequency steps
Radiated RF IEC 61000-4-3	E1 = 3 V/m 80 MHz to 2,5 GHz	80-2500 MHz, 5 V/m with AM 80% @ 1kHz or 2 Hz

3 Temperature and Humidity Specifications

3.1 System Suite



NOTICE

If these temperature and humidity specifications are not strictly adhered to, failures of the Gradient Amplifier Module of the System Cabinet may occur.

Use the specifications listed in [Table 5-3](#) for designing your HVAC (heating, ventilation, and air conditioning) system. Proper insulation and moisture barrier should be installed within the environmental controlled space (e.g. area above drop ceiling) for humidity, condensation, and temperature control.

NOTE: To help prevent a patient from feeling uncomfortably warm during a scan, make sure the magnet room temperature does not exceed 69.8°F (21°C) maximum.

Table 5-3: Temperature And Humidity Specifications

Area	Temperature		Humidity		Max. Room Gradient °F (°C)
	Range °F (°C)	Change °F/Hr (°C/Hr)	Range %	Change %/Hr	
Equipment Room at In-let to Equipment	59-89.6* (15-32)*	5 (3)	30-75*	5	5 (3)**
Magnet Room	59-69.8 (15-21)	5 (3)	30-60*	5	5 (3)
Operator's Control Room	59-89.6* (15-32)*	5 (3)	30-75*	5	5 (3)
Note					
* Non-condensing humidity with 50% nominal at 65°F (18.3°C).					
** Room temperature gradient specification applies from floor to height of top discharge of equipment cabinets.					

3.2 MRCC Operating Environment

The MRCC is designed to be located external to the building and operate in environments meeting the following specifications.

- Operating Ambient Temperature: -22°F (-30°C) to 110°F (43°C)
- Operating Humidity: 5 to 100%

3.3 Outdoor Unit (CNA-61D-C) Operating Environment

- Operating Temperature : -30°C to 45°C
- Operating Humidity : 20 to 95 %
- For Snow Area: In case the outdoor unit is placed in snow region, install a snow guard over it.
- Noise of Outdoor Unit: 67dB (Max)
- Heat Output of Outdoor Unit: 8KW for 50Hz, 9.2KW for 60Hz

4 Air Cooling

contains the heat output of the equipment listed in the typical site location. These values do not include people, lights and non-MR equipment. Actual site average values will vary depending on system use (i.e. protocols used, patient load, etc.). Note any variations of equipment location for your site when calculating your cooling requirements for each room.

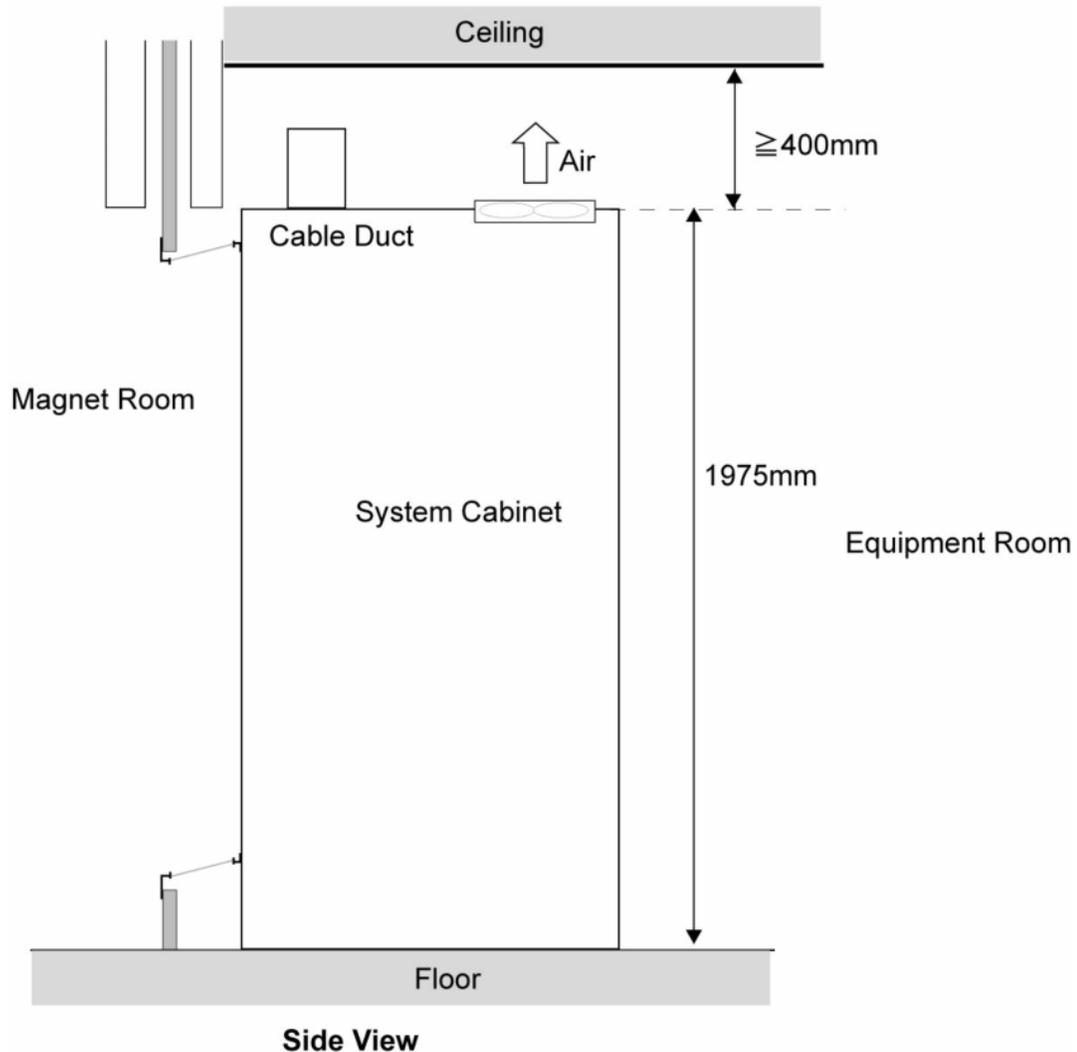
Table 5-4: Signa HDe 1.5T System Maximum Heat Output For Air Cooling *

MR Component	Magnet Room		Equipment Room		Operator/Control Room	
	See Note 1 listed below		See Note 2 listed below			
	BTU/hr	Watt	BTU/hr	Watt	BTU/hr	Watt
RF/Gradient Body Coil Assembly, Magnet Enclosure Equipment	8189	2400				
Patient Blower Box	3415	1000				
System Cabinet			9,560	2,800		
Water Chiller for Gradient Coil (w/ Equipment Room)**			14,000	4100		
MRCC for Gradient Coil and Cooling Box (w/o Equipment Room)**			52,550	15,400		
Water Chiller for SC (MCS) ***			19,613	5,740		
Water Chiller for SC (LCS) ***			5,695	1,670		
Magnet Monitor			205	60		
Shield/Cryo Cooler Compressor -Air Cooled (w/ Equipment Room)****			28,100	8,240		
Shield/Cryo Cooler Compressor -Water Cooled (w/ Equipment Room)****			171	50		
Outdoor Type Shield/Cryo Cooler Compressor -Air Cooled (w/o Equipment Room)**** (See Note 4)						
Operator Workspace with LCD Color Display (See Note 3)					4950	1450
GE pre-engineered Main Disconnect Panel **			900	264		

MR Component	Magnet Room		Equipment Room		Operator/Control Room	
	See Note 1 listed below		See Note 2 listed below			
	BTU/hr	Watt	BTU/hr	Watt	BTU/hr	Watt
Notes						
<p>* Maximum heat output is defined for temperature and humidity as defined in Temperature and Humidity Specifications.</p> <p>** One out of two is used according to the site specification.</p> <p>*** One out of two is used according to the site specification.</p> <p>**** One out of three is used according to the site specification.</p> <p>1. Magnet Room must be an individual temperature zone controlled by a separate thermostat to allow for adjustments to meet room specifications as listed in Temperature and Humidity Specifications. It is recommended that cool inlet air be directed towards the Blower Box intake which contain a patient cooling fan.</p> <p>2. FOR EQUIPMENT ROOM ONLY: Although the air cooling load averaged over a 12 hour working day is approximately 1/2 of the maximum value, the Equipment Room HVAC system must be sized such that Maximum Room Gradient, Temperature Range, Temperature Change per Hour, and Humidity specifications per Temperature and Humidity Specifications are not exceeded at any point during the working day. Actual heat output is site specific and dependent on the specific MR system configuration and customer usage of the MR system and options.</p> <p>3. Operator Workspace equipment includes the following: LCD Color Monitor, GOC Computer Cabinet, Mouse and Mouse Pad, and SCIM Keyboard.</p> <p>4. These units are located at outdoor for Type A Configuration .</p> <ul style="list-style-type: none"> ○ MRCC : 52,550BTU/hr (15400W) ○ Outdoor Shield Cooler: 28,100 BTU/hr (8,240W) 						

Illustration 5-1: Ceiling Height Specification of Equipment (or Operator) Room

Notice: Keep the gap between top of System Cabinet and Ceiling more than 400mm for air blow from System Cabinet.



4.1 Requirements

Physical placement of the air conditioning equipment (compressor, etc.) is an important factor due to the homogeneous field requirements of the magnet. Therefore, it is important this equipment be located outside the 10 gauss line. Refer to [Chapter 4, Magnetic Field](#) for plot of gauss lines.

The Magnet Room must be an individual temperature zone controlled by a separate thermostat to allow for adjustments to meet room temperature specification as listed in [Temperature and Humidity Specifications](#). It is recommended that cool inlet air be directed towards the Enclosure Rear Pedestal and Blower Box air intake for patient cooling.

4.2 Recommendations

A dedicated air conditioner with a dual compressor is preferred to avert shutdowns during repair of the primary air conditioner. Due to the large variation in heat loads, the compressors should be equipped with unloaders, reheaters, or hot gas bypass to prevent moisture stripping of the evaporator coils.

It is recommended that a temperature and humidity recorder be used during preinstallation and during actual installation and placed near the System Cabinet air inlets to establish the true criteria. Refer to cooling table calculator in this section for each room's cooling requirements.

5 Water Cooling

5.1 Gradient Coil Water Cooling

When MRCC(outdoor) is used (If Equipment Room does not exist)

The BRM Gradient Coil is air and water cooled. A water-to-air Water Chiller (WC1) is provided with the Equipment Room site system. De-ionized water and anti-freeze mixture is supplied with the MR system for use in the closed loop system.

NOTE: The Water Chiller(MRCC) is a dedicated closed loop unit for BRM Gradient Coil water cooling and Colling Box.

NOTE: The BRM Gradient Coil has GE provided flexible hose (0.5 in. (12.7 mm) inside diameter) and adjustable compression clamps for connections. Refer to [Chapter 7, L1 / L2 Interconnects](#) for flexible hose routing information.

When Water Chiller is used (If Equipment Room exist)

The BRM Gradient Coil is air and water cooled. A water-to-air Water Chiller (WC1) is provided with the fixed site system. De-ionized water and anti-freeze mixture is supplied with the MR system for use in the closed loop system.

NOTE: The Water Chiller is a dedicated closed loop unit for BRM Gradient Coil water cooling only and not to be shared with other equipment.

NOTE: The BRM Gradient Coil has GE provided flexible hose (0.5 in. (12.7 mm) inside diameter) and adjustable compression clamps for connections.[Chapter 7, L1 / L2 Interconnects](#)

5.2 Gradient Coil Temporary Backup Water Cooling

There are no options available to support temporary backup water cooling for the Gradient Coil.



NOTICE

Water cooling must be provided by the system cooling equipment (a MRCC unit or a WC1 unit) ordered with the system to prevent contamination/damage to the coil and for proper image quality.

5.3 Shield/Cryo Cooler Temporary Backup Water Cooling

NOTE: THIS SECTION APPLIES TO INDOOR SHIELD COOLER COMPRESSOR.

Customer provided temporary backup water cooling is recommended for the Shield/Cryo Cooler Compressor Cabinet (MS5). The backup cooling design can utilize open loop city water only as temporary backup during loss of the closed loop water cooling from the MRCC or customer provided water cooling to the Shield/Cryo Cooler Compressor. Long term open loop systems will not allow a chemical equilibrium to be established resulting in continual build up or etching that can take place which will eventually contribute to failure. Water system capacity must be selected to make sure adequate reserve for overcoming all pressure drops and still maintain the required flow rate for the Shield/Cryo Cooler Compressor Cabinet, for water cooling specifications refer to [Shield/Cryo Cooler Water Cooling For Site Provided Water Cooling](#).

NOTE: These water cooling specifications are the requirements at the equipment. The backup cooling system design must have allowances for pressure/temperature changes due to distance located from the Shield/Cryo Cooler Compressor.



CAUTION

Switching the Shield/Cryo Cooler Compressor inlet/outlet cooling from the MRCC to a temporary water backup supply will result in approximately 1.5 gallons (5.5 liters) of 50% mixture of Dowfrost HD and de-ionized water being discharged. This discharge may have site impacts due to local regulatory codes. Make sure to understand and follow local regulatory requirements when designing and implementing a temporary backup water system. The design of the change over equipment from MRCC to city water and vice-a-versa must not allow contamination of the closed loop system in the MRCC.



NOTICE

Continuous water cooling is critical for the Shield/Cryo Cooler Compressor and therefore **MUST** be available 24 hours per day / 7 days per week to maximize proper uninterrupted magnet operation. Water cooling is required immediately upon magnet arrival, temporary water cooling must be provided if permanent site water cooling is not available.

NOTE: Connections to the Shield/Cryo Cooler Compressor requires 0.5 in. (12.7 mm) inside diameter flexible hose and 1.0 in. (25.4 mm) adjustable compression clamps.

5.4 Shield/Cryo Cooler Requirements For Site Provided Water Cooling

NOTE: THIS SECTION APPLIES TO INDOOR SHIELD COOLER COMPRESSOR.

NOTE: The MR Common Chiller (MRCC) Option is a single-loop 10KW 50/60 Hz water chiller that can be ordered and installed to provide water cooling for the Shield/Cryo Cooler Compressor.

The Shield/Cryo Cooler Compressor customer provided water cooling system must be closed loop design. The water cooling design can utilize open loop city water, with required filtering, only as temporary backup during loss of closed loop water cooling system. Open loop systems will not allow a chemical equilibrium to be established resulting in continual build up or etching to take place which will eventually contribute to failure. Water system capacity must be selected to insure adequate reserve for overcoming all pressure drops and still maintain the required flow rate for the Shield/Cryo Compressor.

NOTE: Continuous water cooling is critical for the Shield/Cryo Cooler Compressor and therefore **MUST** be available 24 hours per day / 7 days per week / 365 days per year to maximize proper uninterrupted magnet operation. Water cooling is required immediately upon magnet arrival, temporary water cooling must be provided if permanent site water cooling is not available.

The Shield/Cryo Cooler Compressor closed loop system may be shared with other equipment in the MR suite. The number of sharing systems should be kept to as low as possible in order to minimize contamination and reliability problems. Flow gauges and valves are recommended at all branch lines to control distribution and allow servicing of equipment.

Refer to [Table 5-5](#) and [Table 5-6](#) for water cooling specifications.

NOTE: The Shield/Cryo Cooler Compressor requires customer supplied flexible hose for mating with water cooling. Connections to the Shield/Cryo Cooler Compressor requires 0.5 in. (12.7 mm) inside diameter flexible hose and 1.0 in. (25.4 mm) adjustable compression clamps.

Table 5-5: LCC Magnet Shield/Cryo Cooler Compressor Water Quality Requirements

Parameter	Requirement	Notes
pH level	6.5-8.2	GE recommends the use of de-ionized water to ensure longest life with fewest problems.
Hardness	less than 200 ppm of calcium carbonate	Hard water will produce calcium deposits in the Gradient Coil and Shield/Cryo Cooler Compressor resulting in decrease of cooling efficiency.
Suspended matter	less than 10 mg per liter, less than 150 micron particle size	To meet the specification for suspended matter it is necessary to install a 100-150 micron filter. Install Shield/Cryo Cooler Compressor Cabinet filter at cabinet inlet.
Anti-freeze	Preferred minimum 25% by Volume Maximum 50% by volume	Use stabilized product to reduce corrosion and organic growth. Preferred minimum value to minimize organic growth.

Table 5-6: LCC Magnet Shield/Cryo Cooler Compressor Water Cooling Specifications

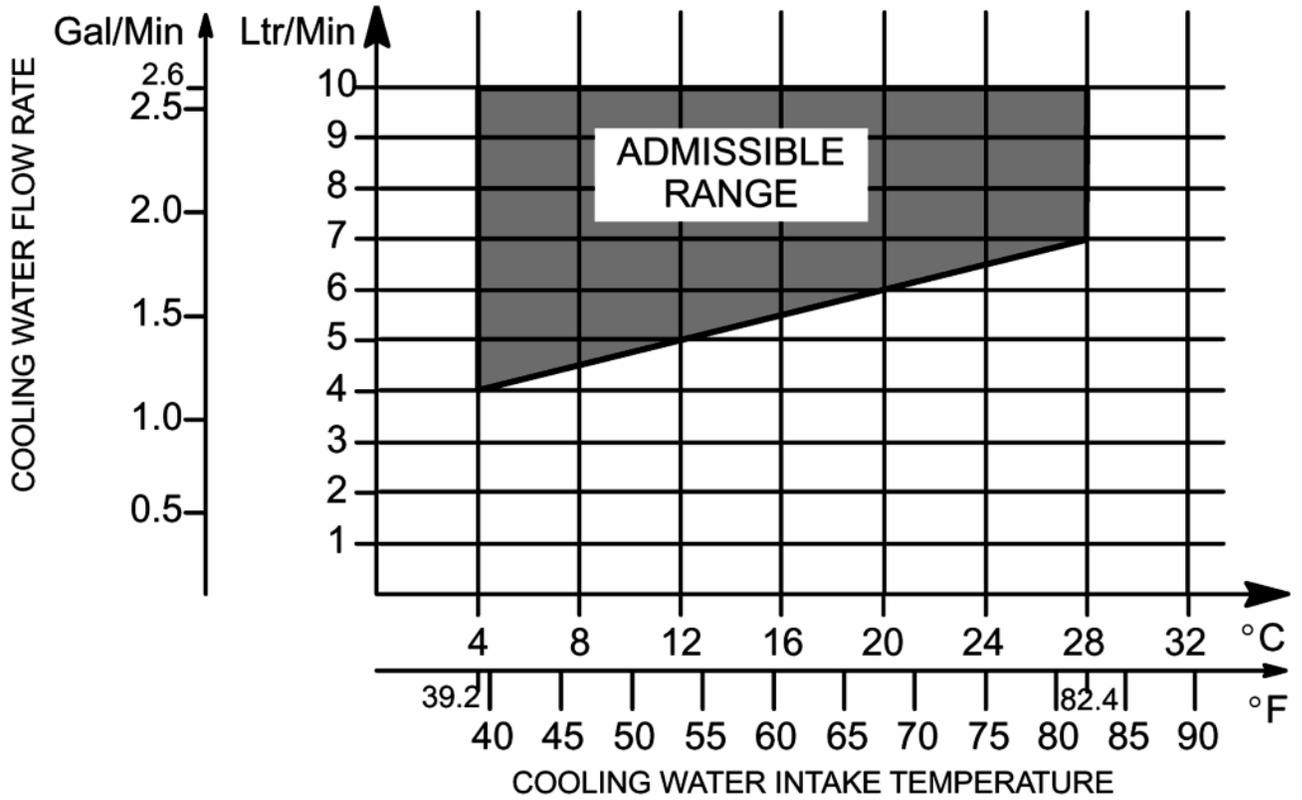
Equipment	Inlet Temperature Range °F (°C)	Inlet Pressure psi (KPa)	Recommended Flow Rate gal/min (liter/min) See Notes 3 & 4	Pressure Drop psi (bar) [KPa] See Note 1 & 7	Temperature Rise Δ°F (Δ°C) See Notes 1, 4, 6, & 8	Typical Heat Output BTU/hr (Watts) See Notes 6 & 8	Maximum Heat Output BTU/hr (Watts) See Notes 6 & 8
Shield/Cryo Cooler Compressor **	39.2 - 82.4 (4 - 28) See Note 9	Minimum 29 (200)	Minimum 1.1 (4) See Notes 2, 3 & 9	7.5 (0.5) [52] at minimum flow rate See Notes 2, 5 & 9	flow rate 48.4 (26.9) for 60 Hz operation 39.4 (21.9) for 50 Hz operation	25,590 (7500) for 60 Hz operation 20,728 (6100) for 50 Hz operation	28,320* (8300*) for 60 Hz operation 23222* (6700*) for 50 Hz operation
		Maximum 100 (690)	Maximum 2.6 (10) See Notes 2, 3 & 9	47 (3.2) [324] at maximum flow rate See Note 2, 5 & 9	at maximum flow rate 19.4 (10.8) for 60 Hz operation 15.7 (8.7) for 50 Hz operation		

Notes

* Ensure water cooling system capacity is capable of dissipating maximum heat output.

1. Pressure drop and water temperature rise across equipment is given for minimum and maximum recommended flow rates as indicated. Pressure drop is measured between coolant inlet and outlet at Shield/Cryo Cooler Compressor unit.
2. Water Flowmeter Kit (46-294052G1) is available to check/monitor flow rate for Shield/Cryo Cooler Compressor. Add 2 psi to total system pressure drop if flowmeter is permanently installed in system.
3. Recommend a flowmeter be permanently installed in system, include flowmeter drop in total system pressure drop.
4. Shield/Cryo Cooler Compressor water flow rate is based on inlet water temperature of 82.4°F (28°C), lower temperature permits lower flow. See [Illustration 5-2](#) for graphic water temperature and flow rate admissible range.
5. Minimum flow rate is for clean water (i.e. without antifreeze), maximum flow rate is for any mixture of water/antifreeze.
6. Water flow rate and temperature rise value are based on water. Laboratory grade Ethylene Glycol or Propylene Glycol anti-freeze may be used (do not mix Ethylene Glycol with Propylene Glycol). Preferred concentration is 65% water and 35% Glycol to minimize organic growth. Concentration of 50/50 is acceptable with a derate of 0.8 in specific heat calculations and a 20% increase in flow with a resultant internal pressure increase of 40%.
7. Pressure drop values based on new system, may rise due to calcification.
8. Shield/Cryo Cooler Compressor temperature rise, typical and maximum heat output are reduced by 18% at 50 Hz operation.
9. There is a risk of damaging the Shield/Cryo Cooler Compressor with water inlet low temperature and low flow range. Water Cooling Circuit typical values:
 - water inlet flow 1.8 to 2.1 gal/minute (7 to 8 liter/minute)
 - water inlet temperature 53.6 to 59°F (12 to 15°C)

Illustration 5-2: Shield/Cryo Cooler Compressor Requirements



6 Altitude

100 ft (30.5 m) below sea level to 7992 ft (2438 m) above sea level.

7 Lighting

Magnet Room Lighting requirements are listed in [Table 5-7](#).

Table 5-7: Magnet Room Direct DC Lighting Requirements

Requirements	
	<div style="background-color: #0056b3; color: white; padding: 5px; text-align: center; font-weight: bold; font-size: 1.2em;">NOTICE</div> <p>Fluorescent lighting is not allowed in the Magnet Room due to the RF noise generated by the fluorescent light tubes.</p> <ol style="list-style-type: none"> 1. Direct Current (DC) lighting is required in the magnet room to avoid RF broadband noise impacts to image quality. 2. Illumination of 300 lux around the front of the magnet for patient access. 3. Need to provide 300 lux above the magnet service work (non-magnetic, portable lighting is acceptable). 4. The AC ripple from the DC power should be not greater than 5%. 5. Discrete switch or variable lighting level DC Lighting Controller (GE option available refer to Chapter 6, DC Lighting Controller (Facility Option)) must be used for selectable light levels. Dimmers (i.e. SCR, rheostats, etc.) are not allowed. 6. Lighting fixtures selection and installation must comply with requirements in Chapter 8, RF Shielded Room Requirements to minimize the possibilities of electrical discharge. 7. Light fixtures must have a ground wire from its power source and be grounded to the RF Shielded Room at the RF Common Ground Stud as shown in illustration in Chapter 6, Grounding System Ground subsection. 8. Light Emitting Diode (LED) lighting, if used, must meet the following: <ol style="list-style-type: none"> a. Power source must be located external to the Magnet Room RF Shield. b. All wiring, filters, and ground requirements must be met, refer to Chapter 6, Grounding System Ground subsection. 9. Battery chargers (e.g. emergency lighting) are required to be located outside the Magnet Room.
Comments	
<ul style="list-style-type: none"> • Short filament length is recommended, linear lamps are not recommended because of the filament length and high incidence of filament failure. • Track lighting fixtures do not comply with light fixtures requirement listed above. 	

8 MR Suite Acoustic Specifications

8.1 Acoustic Specifications

Suite acoustic information is only provided as a guide. The actual room noise level may vary based on room design, optional equipment, and usage.

Table 5-8: Acoustic Specifications

	GE Equipment Acoustic Output (between 20 to 20k Hz)	Notes
Operator Area For Type B Configuration	55 dBA	
Operator Area For Type B Configuration	58 dBA	1m apart from System Cabinet Side cover
Equipment Room	75 dBA	The 75 dBA level is for GE equipment only. The Equipment room acoustic level must not exceed 85 dBA
Magnet Room	127 dBA	

NOTE: Regarding MRCC and Outdoor Shield Cooler Compressor, it is placed at outside. Please consider the environment around the Units and take measures against situation.

- MRCC (MR Common Chiller) 75 dBA
- Outdoor Shield Cooler Compressor for Type A (CNA-61D-C OUTDOOR UNIT) 67dBA (1m apart from Unit)

NOTE: Refer to Architectural acoustic guidelines in [Chapter 12, Acoustic Design Guidelines](#).

8.2 Structureborne Acoustics

Upper floor MR installations represent the largest population of sites which may experience structureborne acoustic issues.

The GE Healthcare VibroAcoustic Damping Option (M1060MA) provides a method to reduce the probability of acoustic structureborne transmission throughout the customer facility.

NOTE: Refer to Architectural acoustic guidelines in [Chapter 12, Acoustic Design Guidelines](#).

8.3 VibroAcoustic Damping Option

The VibroAcoustic Damping Option may be purchased to address site vibration which may contribute to potential structureborne acoustic issues. Amount of vibration attenuation provided by the VibroAcoustic Damping Option will be site dependent.

9 Room Ventilation

Refer to [Table 5-9](#) for ventilation specifications for the magnet and cryogen storage rooms. Refer to [Pollution](#) for air quality specifications.

Table 5-9: Magnet Room Ventilation Requirements

Requirements	
1.	Sufficient air ventilation in the Magnet Room must be maintained, not only for patient comfort during scans but also to maintain proper oxygen level during cryogen replenishment.
2.	An exhaust fan to be placed above RF shielding with appropriate wave guide filtering for quick removal of helium gas if large amounts of helium disperse into magnet room. Inert gas containers, such as dewars, are not air tight.
3.	The Magnet Room exhaust fan intake vent must be located at the highest ceiling plane near the magnet cryogen vent.
4.	The Magnet Room exhaust fan to exhaust to safe outside area and be independent of cryogenic venting.
5.	The Magnet Room exhaust fan and air inlet must be sized for a minimum of 1200 CFM (34 m ³ /minute) and minimum of room 12 air exchanges per hour.
6.	Two manual exhaust fan controls connected parallel, one to be located near the Operator Workspace and second control located in the Magnet Room. <ul style="list-style-type: none"> a. The Magnet Room ventilation switch should be mounted near the Magnet Room door and is the responsibility of the architect and mechanical contractor. b. Refer to Table 5-10 for exhaust fan recommended set-up or Table 5-11 for recommended set-up with optional Oxygen Monitor.
7.	Exhaust fan (customer supplied) to be installed and operating before magnet is moved into room.
8.	Annual customer inspection and cleaning / maintenance of the exhaust fan system (fan, inlet grill/filter, ducts, etc.) is needed to meet the minimum airflow requirement to an outside area.
9.	Provide minimum 2 ft x 2 ft (0.61 m x 0.61 m) pressure equalizing waveguide vent in the magnet room ceiling or in the wall (with waveguide top edge located at ceiling) to prevent positive or negative pressures from interfering with opening of the magnet room door per IEC 60601-2-33 6.8.3 cc.
10.	Minimum 5-7% of outside makeup air to be vented into the Magnet Room. For example, with an air input rate of 1200 cubic feet per minute (CFM) (34 cubic meters per minute), there must be a minimum of 60 CFM (1.7 cubic meters per minute) (5%) of outside makeup air.

Table 5-10: Exhaust Fan Set-Up

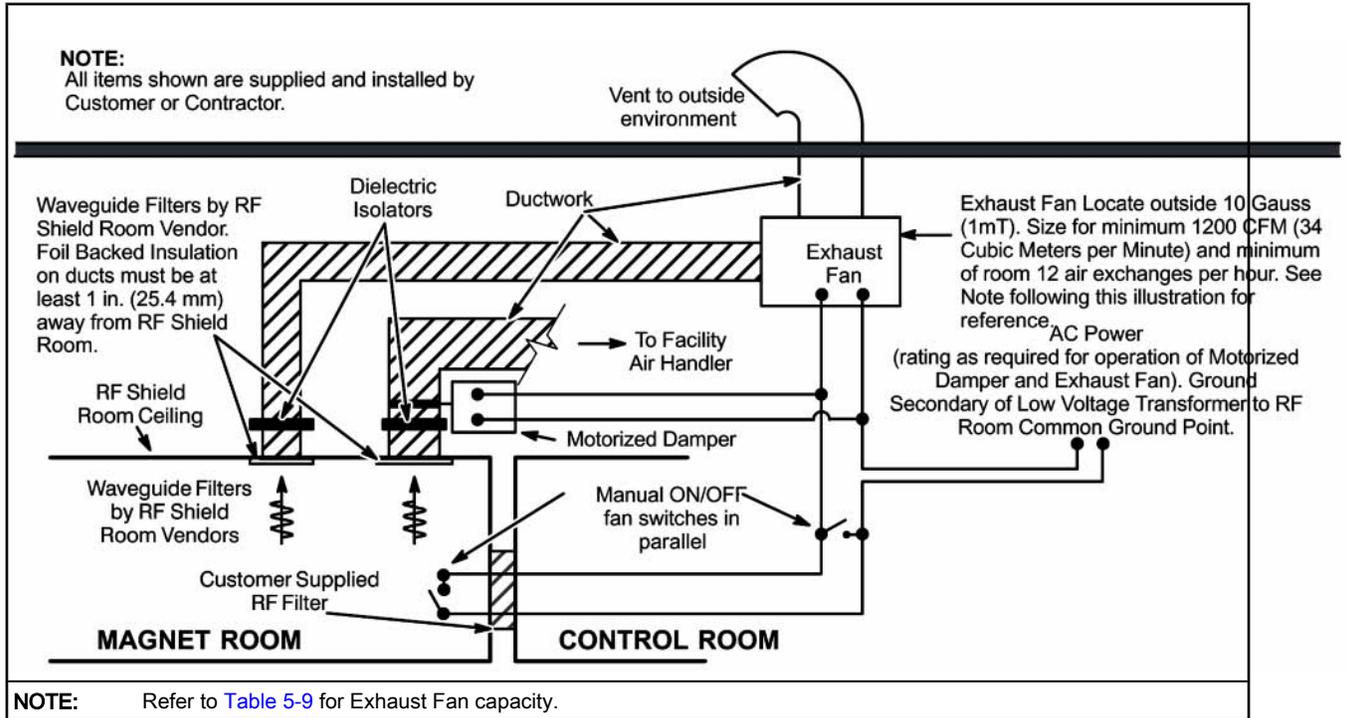
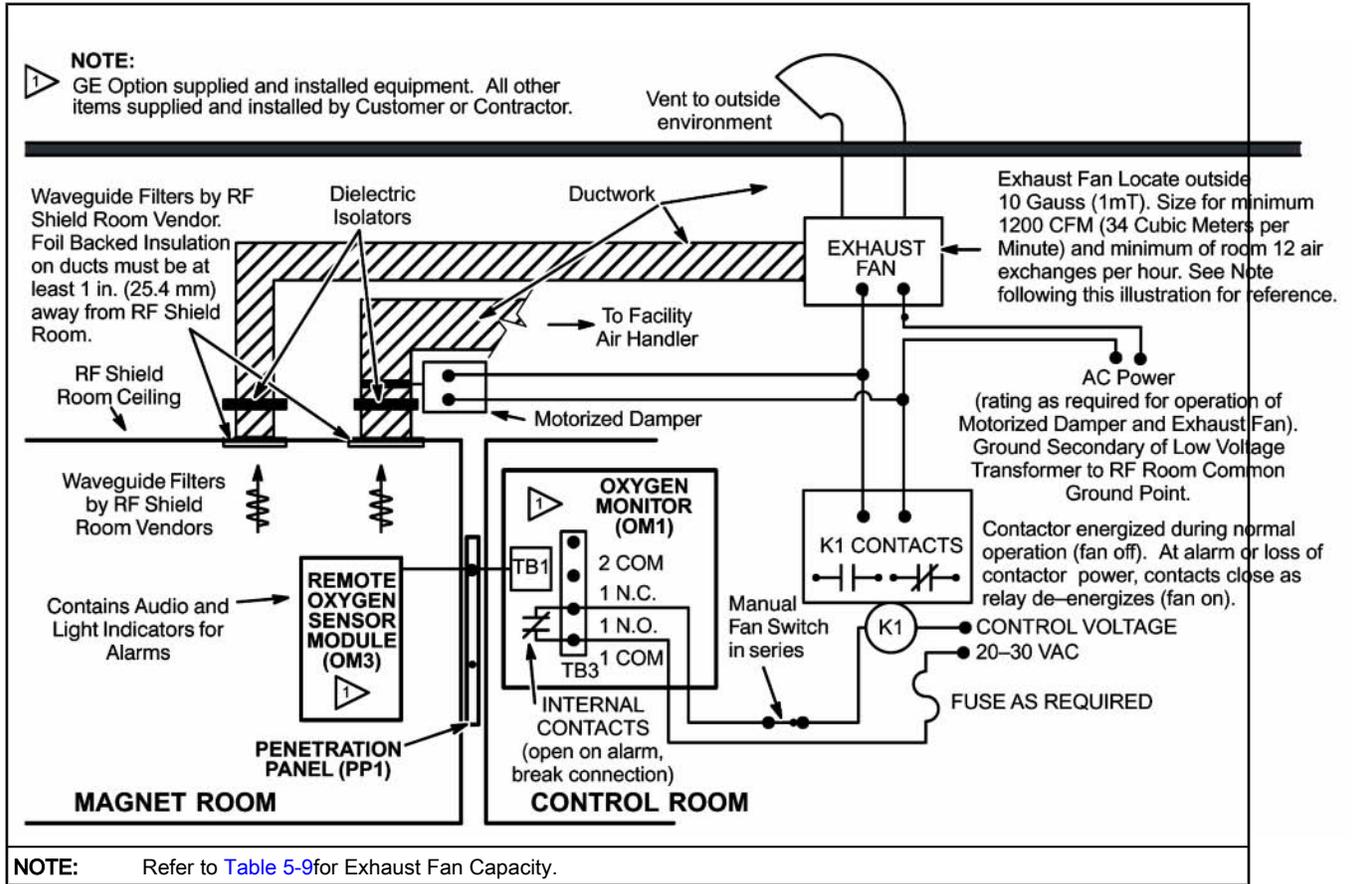


Table 5-11: Exhaust Fan Set-Up With Optional Oxygen Monitor



10 Cryogenic Venting

10.1 Cryogenic Venting Introduction

10.1.1 General Requirements



NOTICE

All venting system components must be accessible for customer inspection, cleaning, and maintenance.

1. The MR System requires an outside vent to allow helium gas to escape during magnet quench. The vent must be properly installed to ensure the gas does not escape into the building
2. The term tube or pipe may be used interchangeably in this document
3. The vent must be connected to the magnet within 24 hours of installation in the magnet room
4. The entire vent system must be accessible for regular inspection and maintenance
5. RF shielded room contractor is to provide one straight pipe with maximum 0.125 in. (3.175 mm) wall thickness for the cryogenic vent pipe/waveguide.
6. The vent pipe/waveguide must extend inside and outside of the RF shielded room
7. Refer to [Chapter 8, Waveguide](#) for additional waveguide requirements

NOTE: All pipe or tube dimensions specified in this document are outside diameters.

NOTE: Some requirements in this document may not be applicable to Mobile, Transportable, or Relocatable configurations.

Table 5-12: Magnet Cryogen Specifications

Magnet Types	Helium Volume gallons (liters)	Peak Helium Flow During Quench ft ³ per min (m ³ per min)	Magnet Vent Pipe OD inches (mm)
1.5T Magnet	520 (1970)	2737 (77.50)	8 (203.2)

10.1.2 Vent Size - Pressure Drop

- The vent must be routed as directly as possible to the outside. If used, elbows must be standard or long sweep.
- The total pressure drop of the cryogenic vent system (from the magnet vent interface to the termination point outside the building) must be less than 17 psi (117.2 kPa). The pressure drop of the RF shield waveguide must be included in the overall calculation.

NOTE: Refer to [Magnet Cryogenic Venting Pressure Drop Reference Tables](#) to calculate the pressure drop.

10.2 Outside Magnet Room Requirements

The waveguide inside the magnet room must be connected to a final exit outside the building. The customer is responsible for design and installation of the venting system.

10.2.1 Vent Support

- The vent support assemblies must be able to support the entire vent system and 1850 lbs (8229 N) helium flow reaction force at vent elbows.
- The Ventglas joint must not be used as a vent system support.

10.2.2 Vent Construction

- Expansion/contraction joints must be provided for temperature decrease from ambient to 4.5 K (-451°F or -268°C)
- A Ventglas isolation joint must be installed at the waveguide. The joint gap must be 1.0 ± 0.25 inch (25 ± 6 mm)
- The Ventglas joint must be accessible for inspection or maintenance
- All components must be rated to withstand the helium flow reaction force at temperatures from ambient to 4.5 K (-451°F or -268°C)
- Electro-mechanical fire dampers must not be used. Fusible link fire dampers may be used (with annual inspection)
- Exit of vent must prevent ingress of weather elements (i.e., rain, snow, hail, sand, etc.) and foreign material debris (i.e., leaves, bird nests, etc.)
- Condensate must be prevented from pooling inside any section of the venting system

10.2.3 Vent Exit



WARNING

CRYO-BURNS OR ASPHYXIATION DURING A QUENCH, EXTREMELY COLD GAS OR PARTICLES ARE RELEASED FROM THE CRYOGENIC VENTING SYSTEM. A QUENCH MAY OCCUR AT ANY TIME.

ENSURE ACCESS TO CRYOGEN VENT EXHAUST AREA IS RESTRICTED AND THE RELEASED GAS DOES NOT REENTER THE BUILDING. REFER TO THE SPECIFICATIONS BELOW.

- The vent exhaust area 20 feet (6.1 m) long by 15 feet (4.6 meters) wide:
 - Must be restricted and labeled with appropriate warning signs.
 - Must not include air intake vents
 - Must not include any personnel, building components, or objects (movable or stationary)
- For a roof-top exit:
 - Use either a horizontal exhaust vent with a 90° elbow and minimal pressure drop or other low pressure drop, high flow rate roof cap
 - The bottom of the 90° elbow must be at least 3 feet (0.9 meters) above the roof deck (or higher if at risk of being blocked by drifting snow, sand, etc.)
 - The outlet must be covered with a 0.5 inch (12.7 mm) square screen mesh
 - The exhaust vent must be included in the pressure drop calculation
- For a side-wall exit:

- Use an exhaust vent with a 45° elbow (with a deflector rated for the helium reaction force) and no restriction in gas flow
- The exhaust exit must be at least 12 feet (3.66 meters) above the ground
- The outlet must prevent foreign material from entering the opening (using mesh screen, louvers, etc.)
- The exhaust vent must be included in the pressure drop calculation

Illustration 5-3: Cryogenic Vent Installation Detail

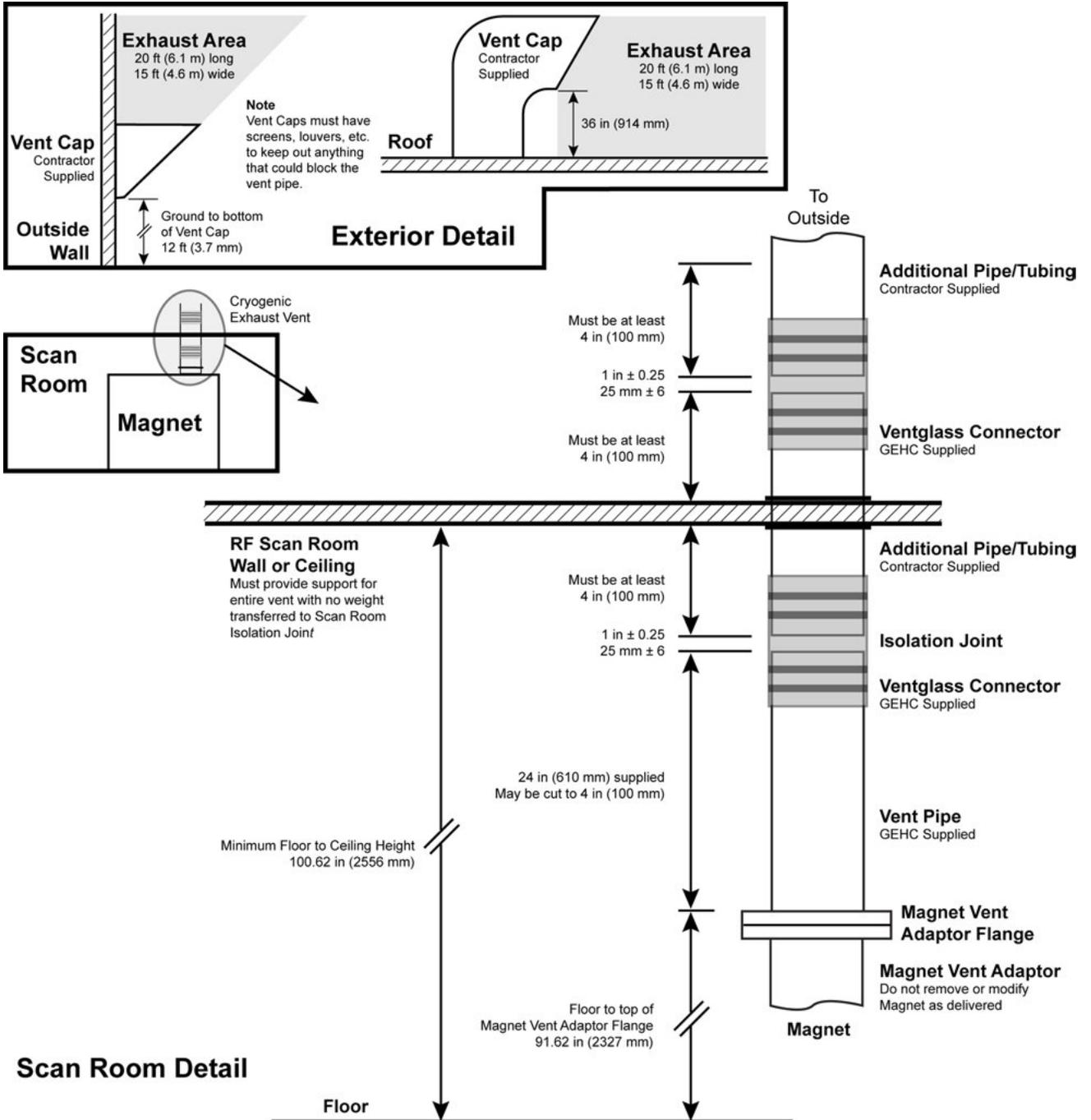
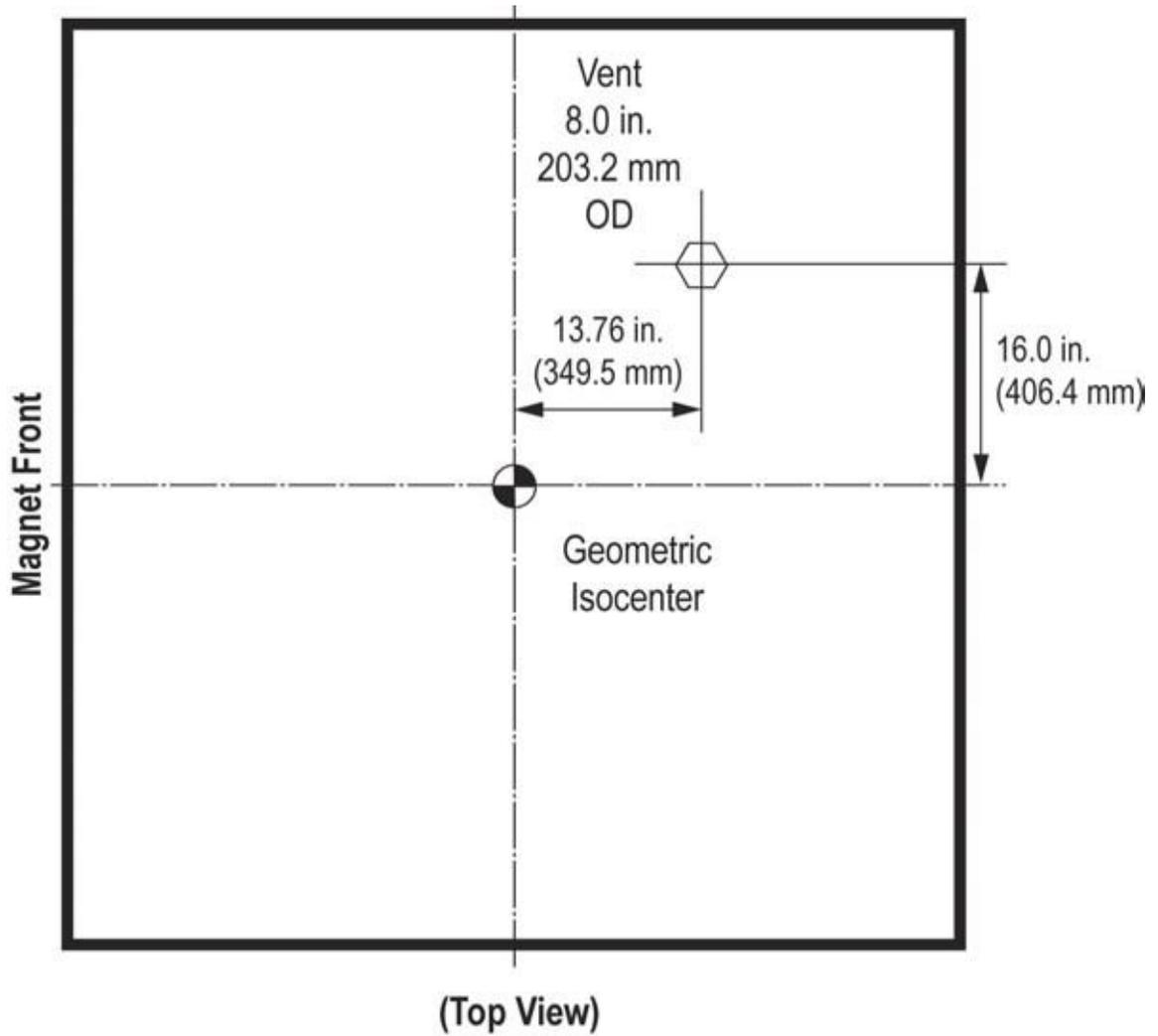


Illustration 5-4: Magnet Cryogenic Vent Location



10.2.4 1.5T LCC Magnet Cryogenic Vent System Pressure Drop

Table 5-13: 1.5T LCC Magnet Sample Pressure Drop Calculation Of Cryogenic Venting

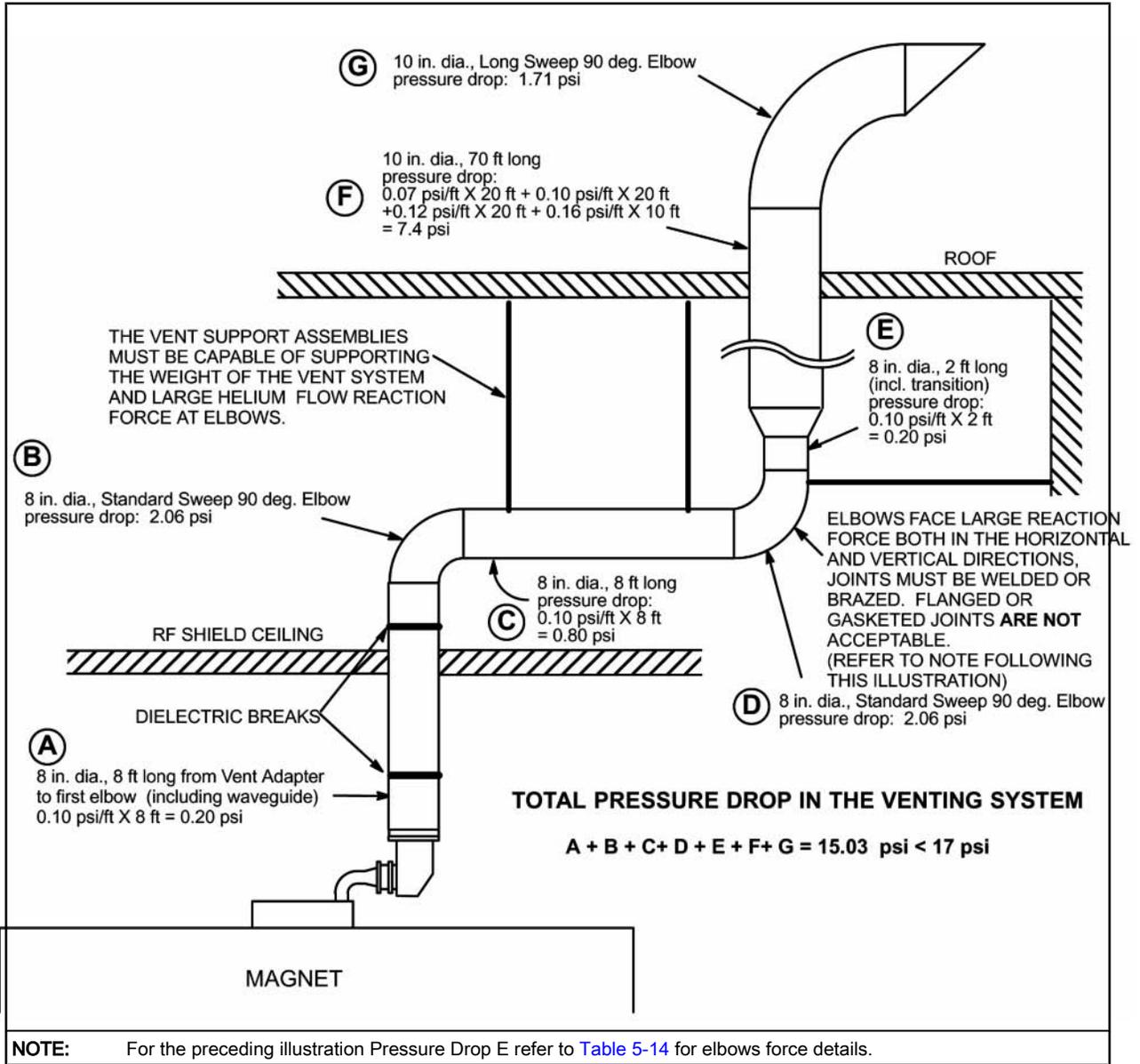


Table 5-14: 1.5T LCC Magnet Cryogenic Vent System Pressure Drop Matrix

Inside dia. of vent pipe (D)	Distance of vent system component from magnet		Pressure drop for straight pipe with smooth inside surface		Std sweep 45° elbow		Std sweep 90° elbow		Long sweep 45° elbow		Long sweep 90° elbow	
	ft	m	psi/ft	kPa/m	psi	kPa	psi	kPa	psi	kPa	psi	kPa
8 in. (203.2 mm)	00- 20	0 -6.1	0.10	2.26	1.10	7.58	2.06	14.20	0.55	3.79	1.03	7.10
	20- 40	6.1 -12.2	0.21	4.75	2.10	14.48	3.70	25.51	1.03	7.10	1.85	12.76
	40- 60	12.2 -18.3	0.30	6.79	2.88	19.86	5.21	35.92	1.44	9.93	2.60	17.92

Inside dia. of vent pipe (D)	Distance of vent system component from magnet		Pressure drop for straight pipe with smooth inside surface		Std sweep 45° elbow		Std sweep 90° elbow		Long sweep 45° elbow		Long sweep 90° elbow	
	ft	m	psi/ft	kPa/m	psi	kPa	psi	kPa	psi	kPa	psi	kPa
	60-80	18.3-24.4	0.38	8.60	3.70	25.51	6.71	46.27	1.85	12.76	3.36	23.17
	80-100	24.4-30.5	0.47	10.63	4.52	31.17	8.22	56.68	2.26	15.58	4.11	28.34
10 in. (250 mm)	0- 20	0 - 6.1	0.03	0.68	0.55	3.79	0.82	5.65	0.27	1.86	0.41	2.83
	20- 40	6.1 -12.2	0.07	1.58	0.82	5.65	1.51	10.41	0.41	2.83	0.75	5.17
	40- 60	12.2 -18.3	0.10	2.26	1.23	8.48	2.19	15.10	0.62	4.27	1.10	7.58
	60- 80	18.3 -24.4	0.12	2.71	1.51	10.41	2.74	18.89	0.75	5.17	1.37	9.45
	80- 100	24.4 -30.5	0.16	3.62	1.92	13.24	3.43	23.65	0.96	6.62	1.71	11.79
12 in. (300 mm)	0- 20	0 - 6.1	0.013	0.29	0.27	1.86	0.41	2.83	0.14	0.97	0.21	1.45
	20- 40	6.1 -12.2	0.027	0.61	0.41	2.83	0.82	5.65	0.21	1.45	0.41	2.83
	40- 60	12.2 -18.3	0.041	0.93	0.55	3.79	1.10	7.58	0.27	1.86	0.55	3.79
	60- 80	18.3 -24.4	0.054	1.22	0.69	4.76	1.37	9.45	0.34	2.34	0.69	4.76
	80- 100	24.4 -30.5	0.069	1.56	0.96	6.62	1.51	10.41	0.48	3.31	0.75	5.17
	100-120	30.5-36.6	0.08	1.81	1.09	7.52	1.77	12.20	0.55	3.79	0.88	6.07
	120-140	36.6-42.7	0.10	2.26	1.27	8.76	2.07	14.30	0.63	4.34	1.04	7.17
	140-160	42.7-48.8	0.11	2.49	1.43	9.86	2.36	16.30	0.72	4.96	1.19	8.21
	160-180	48.8-54.9	0.12	2.71	1.60	11.00	2.53	17.40	0.80	5.52	1.27	8.76
180-200	54.9-61.0	0.17	3.85	1.75	12.10	2.93	20.20	0.88	6.07	1.47	10.14	
14 in. (350 mm)	0- 20	0 - 6.1	0.008	0.055	0.20	1.38	0.301	2.08	0.102	0.70	0.15	1.03
	20- 40	6.1 -12.2	0.017	0.12	0.30	2.07	0.602	4.15	0.154	1.06	0.30	2.07
	40- 60	12.2 -18.3	0.026	0.18	0.40	2.76	0.808	5.57	0.198	1.37	0.40	2.76
	60- 80	18.3 -24.4	0.034	0.23	0.51	3.52	1.01	6.96	0.250	1.72	0.51	3.52
	80- 100	24.4 -30.5	0.043	0.30	0.71	4.90	1.11	7.65	0.353	2.43	0.55	3.79
	100-120	30.5-36.6	0.050	0.34	0.80	5.52	1.30	8.96	0.40	2.76	0.64	4.41
	120-140	36.6-42.7	0.063	0.43	0.933	6.43	1.52	10.48	0.46	3.17	0.76	5.24
	140-160	42.7-48.8	0.069	0.48	1.05	7.24	1.73	11.93	0.52	3.59	0.87	6.00
	160-180	48.8-54.9	0.076	0.52	1.18	8.14	1.85	12.76	0.59	4.07	0.93	6.41
180-200	54.9-61.0	0.11	0.76	1.29	8.89	2.15	14.82	0.64	4.41	1.08	7.45	
16 in. (400 mm)	0- 20	0 - 6.1	0.0053	0.037	0.153	1.05	0.230	1.59	0.078	0.54	0.115	0.79
	20- 40	6.1 -12.2	0.013	0.09	0.229	1.58	0.460	3.17	0.118	0.81	0.229	1.58
	40- 60	12.2- 18.3	0.020	0.14	0.306	2.11	0.618	4.26	0.152	1.05	0.306	2.11
	60- 80	18.3 -24.4	0.026	0.18	0.390	2.69	0.773	5.33	0.191	1.32	0.390	2.69
	80- 100	24.4 -30.5	0.033	0.23	0.543	3.74	0.850	5.86	0.270	1.86	0.421	2.90
	100-120	30.5-36.6	0.038	0.26	0.613	4.23	0.995	6.86	0.310	2.14	0.490	3.38
	120-140	36.6-42.7	0.048	0.33	0.714	4.92	1.16	8.00	0.352	2.43	0.581	4.01
	140-160	42.7-48.8	0.052	0.36	0.803	5.54	1.32	9.10	0.398	2.74	0.666	4.59
	160-180	48.8-54.9	0.058	0.40	0.903	6.23	1.42	9.79	0.451	3.11	0.712	4.91
180-200	54.9-60.1	0.084	0.56	0.987	6.81	1.64	11.31	0.490	3.38	0.826	5.70	

Inside dia. of vent pipe (D)	Distance of vent system component from magnet		Pressure drop for straight pipe with smooth inside surface		Std sweep 45° elbow		Std sweep 90° elbow		Long sweep 45° elbow		Long sweep 90° elbow	
	ft	m	psi/ft	kPa/m	psi	kPa	psi	kPa	psi	kPa	psi	kPa
<p>Notes</p> <ol style="list-style-type: none"> 1. Elbows with angles greater than 90° must not be used. 2. The table data is based on the followings: <ol style="list-style-type: none"> a. Initial flow conditions at magnet interface b. Gas temperature starting at 4.5 Kelvin (-452° F or -268°C). c. Helium gas flow rate of 2,737 cubic feet per minute (77.5 cubic meters per minute) d. 45° standard sweep elbow $K = 15 F_t$ e. 90° standard sweep elbow $K = 30 F_t$ f. 45° long sweep elbow $K = 7.5 F_t$ g. 90° long sweep elbow $K = 15 F_t$ 												

10.3 Inside Magnet Room Requirements

The magnet must be connected to the waveguide inside the magnet room. The customer is responsible for design and installation of the venting system.

10.3.1 General Configuration

- Do not remove or modify the vent adaptor bolted to the magnet
- The GE Healthcare supplied vent tube must be bolted directly to the magnet vent adaptor bolt flange
- The vent tube may be cut to a minimum of 4 inches (10.6 cm) from the top of the magnet flange

10.3.2 Vent Material

- The vent material must be one of the following materials with the wall thickness indicated:
 - SS 304: Minimum 0.035 in. (0.89 mm); Maximum 0.125 in. (3.18 mm)
 - AL 6061-T6: Minimum 0.083 in. (2.11 mm); Maximum 0.125 in. (3.18mm)
 - CU DWV, M or L: Minimum 0.083 in. (2.11 mm); Maximum 0.140 in. (3.56 mm)
- Either tubes or pipes may be used and must be seamless or have welded seams
- Corrugated pipe must not be used
- A bellows pipe less than 1 ft (30 cm) may be used as a thermal expansion joint
- The vent pipe must withstand a maximum pressure of 35 psi (241.4 kPa)
- Waveguide vent material must match the outside diameter of the magnet vent

10.3.3 Vent Support

- The vent support assemblies must be able to support the entire vent system and 1850 lbs (8229 N) helium flow reaction force at vent elbows
- Any vent support must not compromise the integrity of the RF shield
- The Ventglas joint must not be used as a vent system support

10.3.4 Vent Construction

- One dielectric break in the vent system (using Ventglas) is required in the Magnet Room to ensure the integrity of the RF shield for the Magnet Room (it may also serve as a thermal expansion joint)
 - Ensure the gap between the pipes is 1.0 ±0.25 inch (25.4 ±6 mm) using a continuous wrap technique
 - The Ventglas joint must be accessible for annual inspection or maintenance by GE Healthcare
- The customer supplied vent (except the Ventglas joints) must be welded or brazed. No clamped, sealed flanges are permitted
- All isolation/thermal expansion joints (except the Ventglass joint) must be rated to 4.5 K (-451° F or -268° C) and 35 psi (241.4 kPa)
- The vent system must be insulated with 1.5 inch (38 mm) thick flexible unicellular insulation to prevent condensation during magnet ramping. Exposed insulation must be covered with a white PVC jacket
- The installation of the vent pipe section between the waveguide and the supplied magnet vent pipe must not result in any vertical or side load to the waveguide and the magnet vent pipe

11 Alarm Devices, Water Sensors and Thermostats

11.1 Water Sensor Alarm and Floor Drain

It is recommended that customer supplied water sensor alarms and floor drain be located on floors where water cooled cabinets are positioned, especially under raised flooring.

11.2 Pneumatic Patient Alert

The Pneumatic Patient Alert Control Box provides an audible and visual alarm near the operator when the patient depresses the hand held squeeze bulb. The control box is to be mounted with consideration for ease of use by operator, remaining in sight of operator, and remaining within 5 ft (1.5 m) of an electrical outlet. Note, an outlet on the Operator Workspace may be used. Options for control box location include mounting box vertically (on a wall or other vertical surface), horizontally (place box on a counter top, desk top, or other horizontal surface), or under a shelf within sight of operator.

12 Ambient Radio Frequency Interference (RFI)

The MR System utilizes spatially encoded radio frequency information to create the MR image. Therefore, it is sensitive to ambient RFI. To protect the MR from ambient RFI (as well as the local environment from Magnetic Resonance RF), all sites require a 100 dB RF Shield, refer to [Chapter 8, RF Shielded Room Requirements](#) for exact requirements. It is very unlikely that local signals will affect an MR System with a properly designed and installed RF Shield. During the site evaluation visit, GE notes the location of nearby sources of RFI and will advise if further information or on-site testing is required. Most sites do not require on-site testing. Listed in [Table 5-15](#) are the recommended centerband and bandwidth frequencies to be used when measuring radio frequency interference. This table includes those frequency bands which are important for both proton imaging and spectroscopy.

Table 5-15: 1.5T System Radio Frequency Survey Specifications

Isotope	Bandcenter MHz	Bandwidth Hz
¹ H	63.86	916,138
¹⁹ F	60.12	981,882
³¹ P	25.88	390,296
²³ Na	16.90	242,773
¹³ C	16.06	233,925

When required, RFI site surveys are to be performed by cycling through the preceding frequency bands and a broad band range from 10MHz-100MHz. Special emphasis, however, should be placed on the 1H band since this is used in proton imaging. The RFI site survey should be performed for a length of time necessary to determine, within a reasonable degree of certainty, that the RFI noise at the site will not exceed the 100 db attenuation provided by the RF shielded room. Note that any RFI site survey no matter how thorough, will not preclude the possibility of future or unmeasured RFI caused by new or intermittent sources.

The ambient RF noise measured should be less than 100 millivolt per meter (100 dB microvolt per meter). When a RFI site survey is required, it must be completed before the purchase and installation of the RF shielded room.

To ensure that 100 millivolt (or greater) RF noise peaks outside the bandwidths specified above do not actually extend into these bandwidths and exceed the 100 millivolt limit, adjust the resolution of the test equipment (spectrum analyzer) according to the equation:

$$BW \text{ (resolution)} = f_0 / 50$$

where: BW = Bandwidth (resolution)

f_0 = Center frequency (for 1H: at 1.5 Tesla 63.86 MHz)

13 Pollution

The site must be clean prior to delivery of the equipment. Although individual components have filters for optimum air filtration, care should be taken to keep air pollution to a minimum.

When cleaning tile floors, do not use steel wool which could enter cabinet enclosures and cause internal shorts.

The computer/equipment area requires that the air be filtered to remove 90 percent of all particles down to 10 microns and 80 percent of all particles from 10 to 5 microns in size.

14 Changing Magnetic Environment Specifications

NOTE: Also refer to [Chapter 3, Proximity Limits](#) for additional proximity limitations.

14.1 Definition Of Moving Metal

Moving metal means metal objects that move inside of the moving metal sensitivity line during system scans. For example, cars being driven inside the moving metal sensitivity line are moving metal. However, if a car or a dumpster is within the moving metal sensitivity line and does not move during scans, then it is not an issue. Note, the 3 gauss line proximity limit for metal objects still applies to Active Shield magnets.

14.2 Magnet Steel Objects Categories And Requirements

Refer to [Table 5-16](#) for 1.5T Magnet moving metal requirements and see [Illustration 5-6](#) and [Illustration 5-7](#).

Table 5-16: 1.5T LCC Magnet Moving Metal Requirements

Steel Objects Category	Definition Of Distance Location	Minimum Distance Radial X Axial ft (m) See Note 1
Objects 100 - 400 lbs	distance from isocenter radial x axial (See Note 1)	3 Gauss line
Cars, Minivans, Vans, Pickup Trucks, Ambulances	distance from isocenter measured to center of driving or parking lane radial x axial (See Note 1)	15.5 x 21 (4.72 x 6.40)
Bus, Trucks (Utility, Dump, Semi)	distance from isocenter measured to center of driving or parking lane radial x axial (See Note 1)	18.1 x 24.5 (5.52 x 7.47)
Objects > 400 lbs, Elevators, Trains, Subways	Place a directional probe (e.g. flux gate sensor) at isocenter of proposed magnet location aligned along the Z-axis. Measure p-p magnetic field change (dc).	See Illustration 5-5 and see Example in Note 2
Notes		
<ol style="list-style-type: none"> 1. Radial distances are magnet X and Y axis. Axial distances are magnet Z axis. 2. EXAMPLE: For Moving Metal Requirements of objects > 400 lbs category you can use the time history of the occurrence to determine what milligauss level to use. <ol style="list-style-type: none"> a. If the site has elevators/counter weights near the magnet and the elevator can stop on the floors for longer than 20 seconds (which is usually the case), peak-to-peak milligauss reading must be less than 4.43. b. If the site has a subway nearby and the field disturbance is less than 5 seconds, the peak-to-peak milligauss reading must be less than 8.39. c. Use 4.43 milligauss peak-to-peak. 		

Illustration 5-5: Actual Axial Shielding Performance

Actual Axial
 Shielding Performance

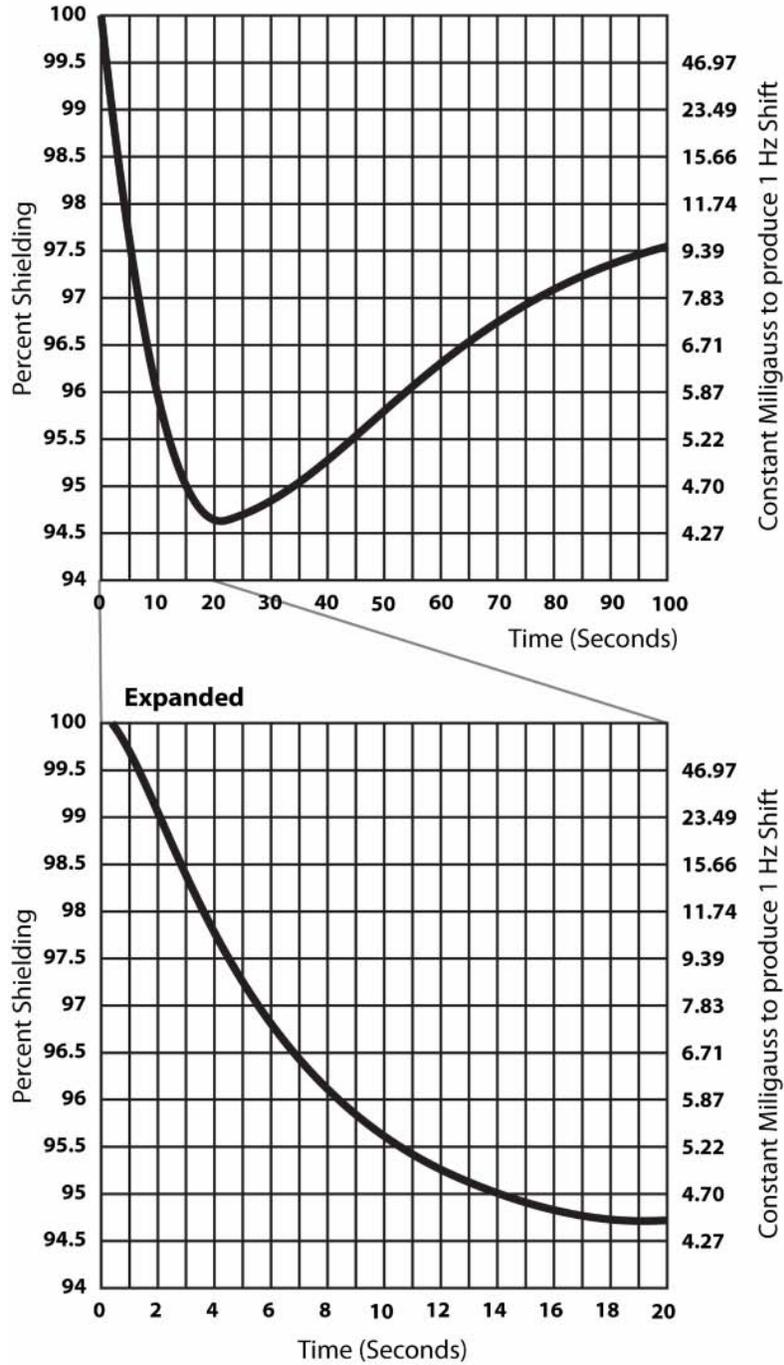


Illustration 5-6: Magnet Moving Metal Sensitivity Line Plot (MR Center Level)

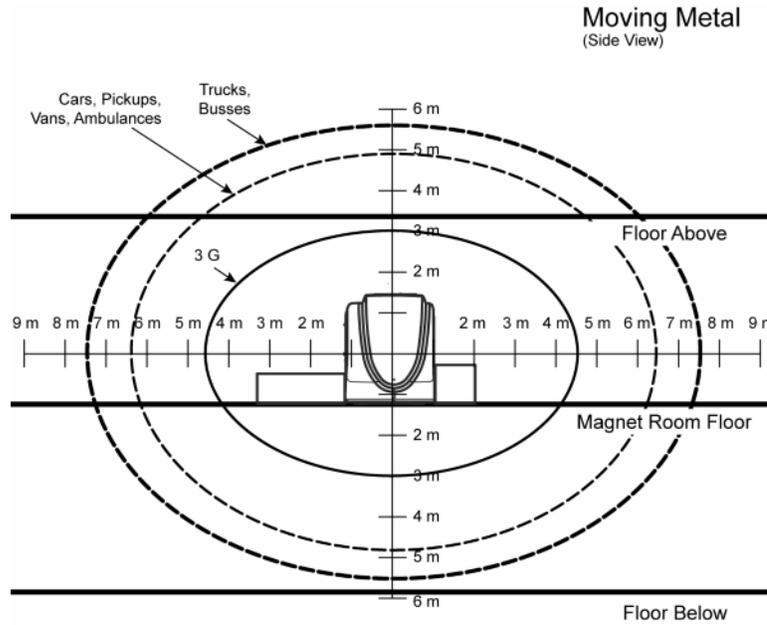
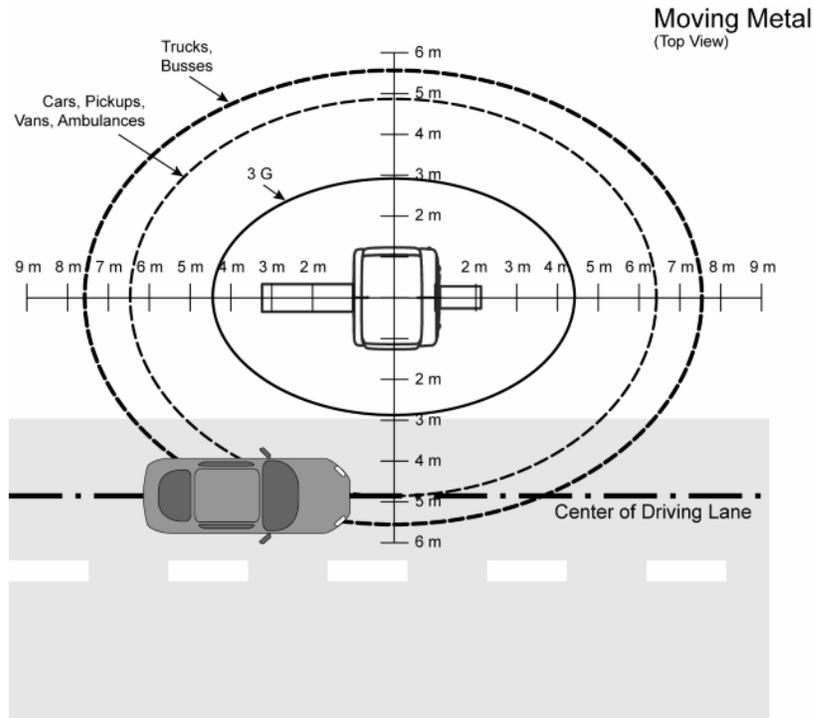


Illustration 5-7: Magnet Moving Metal Sensitivity Line Plot (Vertical View)



14.3 Distances For AC Power Lines, Transformers And Electric Motors

In general most AC equipment in sites is not an issue if it kept outside the 5 gauss line. If a site has large AC equipment (building mains, substations, electric trains, or subways) see [Illustration 5-8](#) and calculate or measure the field along the Z axis at the magnet isocenter.

Electrical currents flowing in high voltage power lines, transformers, and large generators or motors near the magnet can affect the magnetic field homogeneity that is essential to the proper performance of the MR System. Although it is highly unlikely that induced magnetic fields will be a problem, possible sources of AC interference are identified by GE during the site evaluation visit. GE will analyze this information and advise if further shielding or site rearrangement are necessary.

Magnetic field interference at 50 or 60 Hz must not exceed 40 milligauss RMS respectively at the magnet location. The following equation can be used as a general guide in determining allowable current in feeder lines at a given distance from the magnet isocenter.

$$I = (20X^2)/S$$

where:

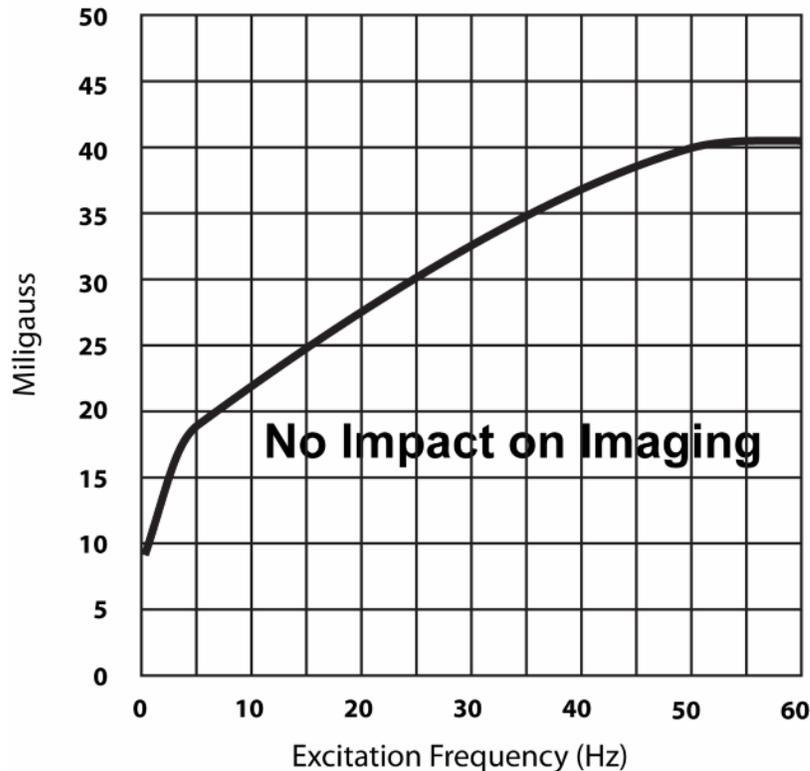
I = Maximum allowable RMS single phase current (in amps) or maximum allowable RMS line current (in amps) in three phase feeder lines

S = Separation (in meters) between single phase conductors or greatest separation between three phase conductors

X = Minimum distance (in meters) from the feeder lines to isocenter of the magnet

Illustration 5-8: Allowable Milligauss VS Line Frequency For AC Equipment

AC Field EMI Limits



14.4 Sample Calculation Determine Minimum Distance From AC Power Lines, Transformers, And Electric Motors

This is a sample calculation to determine minimum distance from a feeder, transformer, or other AC electrical source, using the Formula found in Distances For AC Power Lines, Transformers And Electric Motors.

$$I(\text{amps}) = 8.55X^2(\text{meters}) \div S(\text{meters})$$

Note that the formula has 3 variables, if you have 2 of them, you can calculate the 3rd. In this example, we calculate the minimum distance X from the source, in this case a main electrical feeder carrying 450 amps of current in a 5 inch conduit.

$$X^2(\text{meters}) = [I(\text{amps}) \times S(\text{meters})] \div 20$$

$$X = \sqrt{\left\{ \frac{[I(\text{amps}) \times S(\text{meters})]}{20} \right\}}$$

Rearranging:

Note that the separation "S" is the spacing between the conductors and when all 3 conductors are run in a single conduit, "S" is simply the diameter of the conduit.

$$S = 5 \text{ inches} = 0.127 \text{ meters}$$



$$X = \sqrt{\left\{ \frac{[450(\text{amps}) \times 0.127(\text{meters})]}{20} \right\}}$$

$$X = 1.69\text{meters} = 5.4\text{feet}$$

So in this example, the conduit should be 1.69 meters or 5.54 feet or farther from the magnet's isocenter.

In other situations, the spacing "S" may be the spacing between HV feeders, the distance between transformer lugs, or the spacing between conduits when the phase conductors are run in separate conduits.

What if it is too close? Keep in mind that if this is an existing condition, you should request an *EMI study* to quantify the magnitude and direction of the AC disturbances. The calculation is worse case and does not take into account the vector direction of the AC interference. The magnet is only sensitive to AC disturbances that are directed horizontally (magnet z-axis). Also the calculation does not account for any magnetic shielding effect of steel conduit.

15 Construction Materials

The following recommendations are for maintaining field homogeneity of the magnet. All construction must comply with local and national building codes.

15.1 Magnet Room Floors Magnetic Properties

Table 5-17 information must be used to evaluate site steel in close proximity of the magnet isocenter.

Table 5-17: Steel Mass Proximity To Magnet Isocenter Requirements

Limits Of Steel Mass lbs/ft2 (kg/m2)	Distance From Magnet Isocenter in. (mm)	Distance Below Top Surface Of Floor in. (mm)
0 (0)	0-42 (1067)	0 (0)
2 (9.8)	42-45 (1143)	0-3 (76)
3 (14.7)	45-47 (1194)	3-5 (127)
8 (39.2)	47-52 (1321)	5-10 (254)
20 (98.0)	52-55 (1397)	10-13 (330)

Note

- Limited site materials include steel rebars and other steel building components within a 10 foot by 10 foot (3.1 meter by 3.1 meter) area directly below the magnet.
- If non-uniform steel is present or if these mass proximity limits are exceeded then the steel must be analyzed by the MR Siting and Shielding Team. Refer to *Magnetic Field Consideration Chapter 4, Introduction, Chapter 4, Structural Steel Evaluation Of Proposed Sites*, and *Chapter 4, Magnetic Field*. It is highly recommended to use non-magnetic structural components in the floor below the Magnet.
If the MR Siting and Shielding Team analysis of the site steel determines the steel cannot be shimmed by normal methods, the customer will be required to alter the structural design using non-magnetic materials and/or more favorable geometry. If changes cannot be made, on-site factory shimming at extra cost and extended calibration cycle may be necessary. Also, the GE Field Service Engineer must arrange for delivery of the necessary shim tools and a 1000 amp Power Supply. *Chapter 11, Installation Equipment*.

Steel rebar must not be positioned in such a manner as to interfere with anchor bolt locations for the Magnet Room equipment and the Magnet when the VibroAcoustic Damping Option is not used, refer to *Chapter 8, Magnet Room Equipment Mounting* and Anchor Hardware Requirements sections: *Chapter 8, Anchor Hardware For MR Equipment Inside RF Shield*, *Chapter 8, Clamping Force (Tension) and Pull Test*, *Chapter 8, RF Shield Integrity*, *Chapter 8, Electrical Isolation*, *Chapter 8, Physical Characteristics*, *Chapter 8, Installation Location*.

15.2 Walls, Ceilings, and Fixtures

All electrical and mechanical connections and fasteners including screws, nails, nuts, bolts, clips, clamps, etc. must be sufficiently tightened and secured so as not to become a potential broadband noise source, refer to *Chapter 8, RF Shielded Room Requirements* for broadband noise definition. Standard steel nails, screws, and other hardware are acceptable if properly secured. Any loose steel objects can be violently accelerated into the bore of the magnet. Careful thought should be given to the selection of light fixtures, cabinets, wall decoration, etc. to minimize this potential hazard. For safety, all **removable** items within the magnet room such as switch box cover plates, light fixture components, mounting screws, etc. must be non-magnetic. If you have a specific question about material, bring it to the attention of your GE Healthcare Installation Specialist.

Non-movable steel such as wall studs or HVAC components will produce negligible effect on the magnet.

15.3 Electrical conduits

All electrical and mechanical connections and fasteners including screws, nails, nuts, bolts, clips, clamps, etc. must be sufficiently tightened and secured so as not to become a potential broadband noise source, refer to [Chapter 8, RF Shielded Room Requirements](#) for broadband noise definition. Electrical conduit within the magnet room may be steel provided it is inside walls and ceilings. Note, conduit for a receptacle must be metallic. Ferromagnetic material inside the magnet room could inadvertently become a projectile.

15.4 Plumbing pipes and drains

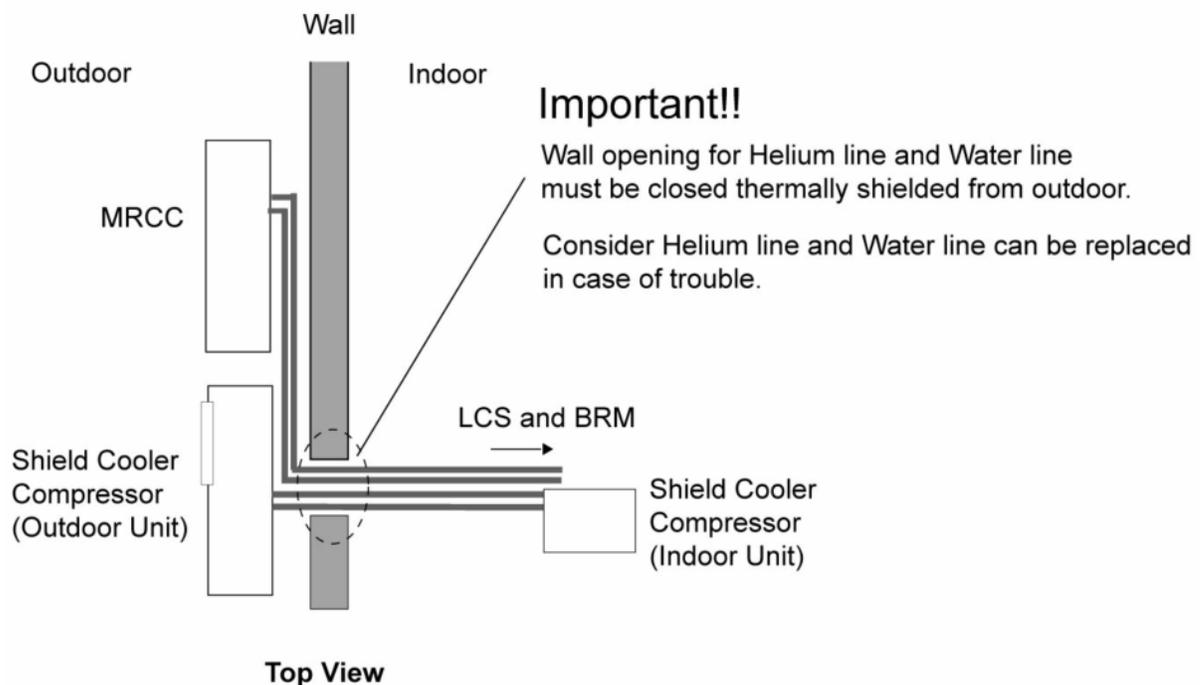
Pipes and drains within the magnet room may be iron, if desired, without significant effect on the magnet homogeneity. For safety, any removable items such as faucet handles, drain covers, etc. must be non-magnetic material such as PVC, copper, or brass. Any magnetic material inside the magnet room could inadvertently become a projectile. Refer to Cryogenic Venting, Requirements For Outside Magnet Room, and Requirements for Inside Magnet Room for cryogenic vent materials requirements.

15.5 Shield Cooler Compressor (Outdoor Type) Wall Penetration

Wall opening for Helium line and Water line must be closed thermally shielded from outdoor.

Illustration 5-9: Wall Thermal Shielding

For Type A configuration Only



16 Vibration

16.1 Types of Vibration Image Quality Issues

MR image quality can be impacted by either steady state or transient vibration. Steady state vibration typically refers to disturbances caused by rotating machinery. Examples of machinery known to have previously generated vibration image quality problems are exhaust fans, air conditioning blower units, compressors, pumps (air and water), etc. Transient vibrations are typically a function of the building structure or the building foundation and are associated with vehicular traffic, pedestrian motion, patient transport, door slamming, etc. A transient event would typically decay from a high vibration amplitude to lower levels in short periods of time.

16.2 Site Planning Vibration Requirements

Magnet Room vibration testing and site planning requirements are listed in [Table 5-18](#).

Table 5-18: Magnet Room Site Vibration Testing And Requirements

Requirements	
1.	The customer is responsible for contracting a vibration consultant or qualified engineer to implement design modifications to meet the vibration specifications as stated in Section 16.3 .
2.	<p>The vibration tests outlined in Chapter 12, MR Site Vibration Test Guidelines must be used to assess the vibration environment. The vibration effects on image quality can be minimized early in the site planning of the MR suite.</p> <ul style="list-style-type: none"> a. Sites which meet the vibration criteria may proceed with the installation planning. b. Sites which fail to meet the vibration requirements will be required to have the customer architect/project engineer provide recommendation to isolate the vibration source(s) and/or recommend structural modifications. <ul style="list-style-type: none"> i. Resolution/solution of measured issue(s) must be communicated to customer/architect, local GE Healthcare Field Service, and GE Project Manager, Installations. ii. A formal report defining the measured issue(s) and resolution/solution to be provided to customer/architect, GE Healthcare Field Service, and GE Project Manager, Installations. c. Sites building a new complex to house the MR suite must use MR Site Vibration Test Guidelines information in the design of the facility.
3.	Air conditioning unit(s) installed for the purpose of cooling the MR Suite must be vibration isolation.
4.	Magnet vibration isolation is not an acceptable solution for environmental vibration issue(s). The magnet must be bolted rigid to a structure or to VibroAcoustic Damping Option mats which set on the finished floor.

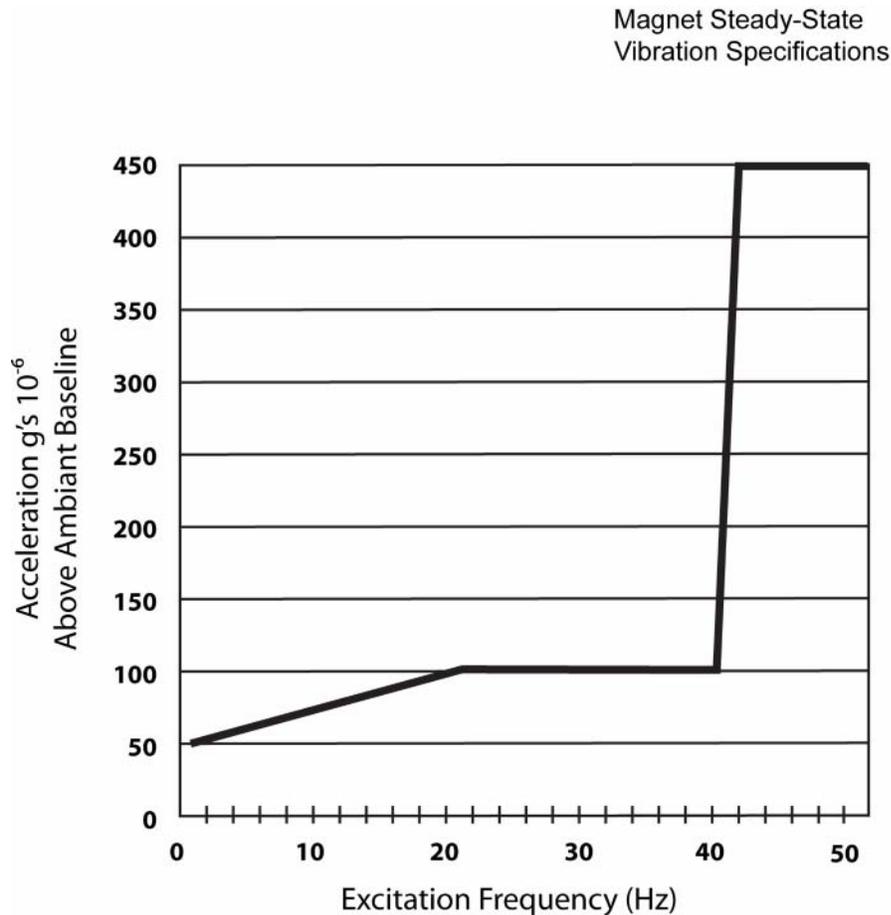
16.3 Vibration Specifications

NOTE: Refer to Appendix [Chapter 12, MR Site Vibration Test Guidelines](#) for definition of ambient baseline.

16.3.1 Steady State Vibration Specifications

The maximum steady state vibration transmitted through the floor should not exceed the following maximum single frequency components above ambient baseline listed in [Illustration 5-10](#).

Illustration 5-10: 1.5T LCC Magnet Steady State Vibration Specifications



Refer to [Appendix Chapter 12, MR Site Vibration Test Guidelines](#) example illustrations for an example applying the steady state specifications with ambient baseline and zoomed in for analysis purposes.

16.3.2 Transient Vibration

NOTE: Transient vibration analysis requires the elimination of all steady state vibration so as not to mask the transient signal. I.E. Variations in acceleration amplitudes due to rotating equipment must not be confused with transient vibration.

1. Time history transient levels exceeding 500 micro-g, zero to peak must be fully analyzed to assess impact to the building structure.
2. The building (spectral) response immediately following the 500 micro-g trigger level must not cause the site environment to exceed the Steady State Vibration levels defined in .
 - a. The vibration consultant must measure and report the transient disturbance of concern.
 - b. The consultant must determine (assess) the frequency, amplitude, and duration of the transient.

- c. The consultant must determine whether the disturbance will vibrate the building structure, MR RF Shielded Room, plus the magnet to amplitudes that would exceed the Steady State Vibration specifications, refer to .

This page left intentionally blank.

Chapter 6 Power Requirements

1 System Power Introduction

The MR system includes a Power Distribution module (PD1) in the lower portion of the System Cabinet which distributes power to most MR system components. Refer to 'Critical Power Requirements' for required customer power specifics.



WARNING

THE FACILITY TRANSFORMER AND FEEDER WIRES NEED TO BE CORRECTLY SIZED FOR THE SIGNA SYSTEM POWER DEMANDS.



WARNING

CUSTOMER SUPPLIED MAIN DISCONNECT PANEL DESIGN NEEDS TO HAVE CORRECTLY SIZED WIRES AND RATED COMPONENTS TO MEET THE MR SYSTEM POWER REQUIREMENTS.



WARNING

IF AN UNINTERRUPTIBLE POWER SUPPLY (UPS) WILL BE PROVIDING POWER TO THE ENTIRE MR SYSTEM THEN THERE IS A NEED TO MAKE SURE THE UPS OPERATION PARAMETERS ARE COMPATIBLE WITH THE SIGNA SYSTEM POWER AND REGULATION DEMANDS.

Customers should carefully consider the advantages and disadvantages of raised flooring, conduits, floor ducts, and surface raceways for running cables in accordance with local codes. If used, conduits should be large enough to pass any cable and its connector through with all other cables in the conduit.

To reduce voltage regulation problems and wiring costs, minimize the cable length between the primary power source and the Power Distribution Unit. When routing cables, keep all phase conductors and ground for a circuit in the same trough. Whenever possible, keep power cables away from signal and data cables. Use separate trough or dividers in duct.

Table 6-1: Required Customer Power

MR Component	Voltage (VAC)	Frequency	Phase	Max. Amps	Comments
Power Distribution Unit (PD1) Module located in the lower portion of System Cabinet. See Notes 1 & 4 See Note 5 if customer MDP	480Y/277 VAC 10% or 415Y/240 VAC 10% or 400Y/230 VAC 10% or 380Y/219 VAC 10% or 208Y/120 VAC 10% or 200Y/115 VAC 10%	60 Hz or 50 Hz	(3+GND) See Comments	See Note 2	Recommend input configuration: 3 phase Grounded WYE with Neutral and Ground (5 wire system). Note, Neutral must be terminated prior to PDU or inside the Main Disconnect Panel and not brought to the System Cabinet. Optional input configuration: 3 phase DELTA with Ground (4 wire) input, rec-

MR Component	Voltage (VAC)	Frequency	Phase	Max. Amps	Comments
					ommend corner Grounded Delta configuration
*Shield/Cryo Cooler Cabinet	460, 480 380, 400, 415	60 Hz 50 Hz	3+GND	9 KVA	Hard wired in unit and at facility power (no power connector). Shield/Cryo Cooler Compressor power and water cooling MUST be available 24 hours per day / 7 days per week to maximize proper uninterrupted magnet operation. Also see Note 3.
*Shield/Cryo Cooler Cabinet (Air Cooled)	200	60 Hz/50 Hz			
See Note 7					
* Shield/Cryo Cooler Cabinet (Outdoor Air Cooled) (w/o Equipment Room) Note: There are two types of Outdoor Air Cooled Shield/Cryo Cooler Cabinet. Select one according to the catalog. -CNA-61C for 200V -CNA-61D for 380, 400, 415, 460, and 480 V	460, 480	60 Hz	3+GND	Minimum: 11 kVA Recommended: 14 kVA	
	380, 400, 415	50 Hz			
	200	50/60 Hz			
Magnet Rundown Unit	100-120 or 200-240	50/60 Hz	1	1.0	
Magnet Monitor	100/120 or 200/220	50/60 Hz	1	0.75	Receptacle required, Magnet Monitor power is required to be ON 24 hours per day to minimize cryogen costs and for proper LCC Magnet performance. Also see Note 4.
Service Receptacle in Magnet Room	110-120 See Comments	50/60 Hz	1	2.0	Receptacle required for small power tools. Local voltage and portable transformers for voltages values.
*MR Common Chiller (MRCC) for BRM and Cooling Box	460/480 ± 10%	60 Hz	3	6.2	15 Amp minimum circuit required, customer supplied power wire, 6 AWG (16 mm ²) maximum wire size.
	380/400 ± 10%	50 Hz			
***O ² Monitor	110-120 or 200-240	50/60 Hz	1	3.0	Hard wired in monitor

MR Component	Voltage (VAC)	Frequency	Phase	Max. Amps	Comments
Notes					
* One out of three can be selected. Refer to Chapter 2, catalog .					
** For equipment room less configuration					
*** Optional equipment.					
1. Power phase conductors, neutral (if present), and ground conductor must be routed inside the same raceway, cable tray, trench cable, or cord per National Electric Code (NEC) 2005 or 2002 Articles 250.134, 300.3, 517.13.					
2. Maximum amps dependent on voltage selected.					
3. Shield/Cryo Cooler Cabinet power and water cooling are required immediately upon magnet arrival. If permanent site power is not ready, temporary drop line must be made available. If site voltage is not any of the voltages listed above, customer must provide transformer and secondary circuit breaker to provide correct voltage and/or configuration.					
4. The complete MR System Digital Energy SG Series UPS 100KVA (E4502FB) option requires 480 VAC, 3-phase, 4 wire + ground, 60 Hz input power.					
5. If customer provided MDP has been selected then Customer provided MDP MUST meet all MDP requirements.					

2 Critical Power Requirements

The facility shall provide a Main Disconnect Panel with Low Voltage Low Energy local and multi-point remote control capability in the feeder lines that supply input power to the Shield Cooler Compressor Cabinet and the Power Distribution Unit (PD1). A GE pre-engineered Main Disconnect Panel is an option available per flowcharts in [Chapter 2, Basic System](#).



NOTICE

If customer provided MDP has been selected then customer provided MDP **MUST** meet all MDP requirements.

Refer to [Main Disconnect Panel \(MDP\) Requirements](#) for Main Disconnect Panel capability and set up.

All work is to be done in accordance with national and local electrical codes.



WARNING

THE FACILITY TRANSFORMER AND FEEDER WIRES NEED TO BE CORRECTLY SIZED FOR THE SIGNA SYSTEM POWER DEMANDS.



WARNING

IF AN UNINTERRUPTIBLE POWER SUPPLY (UPS) WILL BE PROVIDING POWER TO THE ENTIRE MR SYSTEM THEN THERE IS A NEED TO MAKE SURE THE UPS OPERATION PARAMETERS ARE COMPATIBLE WITH THE SIGNA SYSTEM POWER AND REGULATION DEMANDS.

Table 6-2: Critical Power Requirements

Parameter	Requirements
Configuration	<ul style="list-style-type: none"> Recommend input configuration 3 phase solidly Grounded WYE with Neutral and Ground (5 wire system). Note, Neutral must be terminated prior to or inside the Main Disconnect Panel and not brought to the System Cabinet. Optional input configuration 3 phase DELTA with Ground (4 wire) input, recommend corner Grounded Delta configuration.
Frequency	50 ± 3 Hz or 60 ± 3 Hz
Regulation	4% maximum at system maximum power demand (averaged over 5 seconds) from source to PDU (i.e. includes all feeders and transformer to utility)
Phase Balance	Difference between the highest phase line-to-line voltage and the lowest phase line-to-line voltage must not exceed 2%
Daily Voltage Variation	10% from nominal under worst case line and load regulation
PDU Voltage	200/208/380/400/415/480 VAC 10%

Parameter	Requirements
Shield/Cryo Cooler Compressor Voltage (Water Cooled Type)	380/400/415 VAC 50 Hz or 460/480 VAC 60Hz
Shield/Cryo Cooler Compressor Voltage (Air Cooled Type)	200VAC
Coldhead MRCC Voltage	380/400 VAC 10% 50 Hz or 460/480 VAC 10% 60Hz
Gradient MRCC Voltage	
Magnet Monitor equipment Voltage	100/120 or 200/220 VAC
Voltage Transients	Phase-to-phase voltages must be within 2% of the lowest phase-to-phase voltage. Maximum allowable transient voltage above or below nominal waveshape not to exceed 200 V at a maximum duration of 1 cycle and frequency of 10 times per hour.
Facility Zero Voltage Reference Ground	<ul style="list-style-type: none"> Main facility ground conductor to Main Disconnect Panel (MDP) shall be copper and the minimum as required by the local coding regulations, such as the National Electric Code (NEC) 2005 or 2002 Article 250.122. Main facility ground wire to be insulated. Ground impedance to earth at power source to be 2 ohms or less. Main facility ground wire to be bonded at every distribution box in an approved grounding block.
Maximum Momentary Demand	<p>The power demands specified as a function of the duration of the power demand. Table 6-3 lists points on the curve.</p> <p>The power system feeding the Signa system must be designed to meet the specifications of less than 4% regulation when loaded at the 5.0 second allowable consumption. For short intervals the Signa system power demands can exceed the 5.0 second value and the line voltage delivered to the system will sag below the 4% regulation. The Signa system is designed to tolerate these short voltage sags.</p>
Average (while scanning) Power Demand	20kVA for PDU and 9KVA (continuous operation) for Shield/Cryo Cooler Cabinet. See Note1.
Standby (no scan) Power Demand	13.4 KVA at 0.9 lagging Power Factor including 4.4 KVA for PDU and 9KVA (continuous operation) for Shield/Cryo Cooler Cabinet. See Note1.
Notes	
<p>1. For Type A and Type C configuration, subtract 1.7KVA from the value for PDU since water chiller for BRM is not used for these types. Water Chiller for BRM (1.7KVA) is only used for Type B configuration.</p>	

Table 6-3: System With BRM Coil Peak Power Demand

System Equipment (See Note 1)	Power Demand
PDU draw for 5.0 sec . See Note 4	~35 KVA
PDU draw for 1.0 sec or less. See Note 2 and Note 4	~40 KVA
Magnet Monitor. See Note 3	4.5 KVA
Shield/Cryo Cooler Compressor.	9 KVA
TOTAL for 5.0 sec. See Note 4	~48.5 KVA
TOTAL for 1.0 sec or less. See Note 4	~53.5 KVA

System Equipment (See Note 1)	Power Demand
<p>Notes</p> <ol style="list-style-type: none"> 1. MRCC option for Shield/Cryo Cooler Compressor water cooling or Customer provided water cooling equipment power demands are not included in the values in this table. The GE pre-engineered MDP option (E4503AT) option does not support the MRCC. Customer is responsible for the power requirements of water cooling equipment power demands. 2. The PDU draw on the line will not exceed list values. The ACGD Power Supply may provide up to 170 KVA for 0.003 seconds from supply internal capacitance but the supply will recharge capacitors at a power level less than 65 KVA. 3. The Magnet Monitor equipment power is 1.5 KVA 1 phase on an unbalanced leg of 3 phase input (4.5 KVA 3 phase equivalent). 4. For Type A and Type C configuration, subtract 1.7KVA from the value listed since water chiller for BRM is not used for these types. Water Chiller for BRM (1.7KVA) is only used for Type B configuration. 	

3 Power Distribution System

3.1 Main Disconnect Panel (MDP) Requirements



NOTICE

If customer provided MDP has been selected then customer provided MDP MUST meet all MDP requirements.



WARNING

CUSTOMER SUPPLIED MAIN DISCONNECT PANEL DESIGN NEEDS TO HAVE CORRECTLY SIZED WIRES AND RATED COMPONENTS TO MEET THE MR SYSTEM POWER REQUIREMENTS.



WARNING

IF AN UNINTERRUPTIBLE POWER SUPPLY (UPS) WILL BE PROVIDING POWER TO THE ENTIRE MR SYSTEM THEN THERE IS A NEED TO MAKE SURE THE UPS OPERATION PARAMETERS ARE COMPATIBLE WITH THE SIGNA SYSTEM POWER AND REGULATION DEMANDS.

3.1.1 MDP for Type B

Required Main Disconnect Panel shall consist of two three-pole, 600 VAC circuit breakers trip rated for the appropriate current. The short-circuit current interrupting rating of the breaker must be sized to accommodate fault current available.

NOTE: The MDP circuit breaker for lines providing power to Shield/Cryo Cooler Compressor and PDU must be capable of handling the magnetizing inrush current of the Shield/Cryo Cooler Compressor and transformer of the PDU module (PD1) in the HFD/PDU Cabinet (MR3).

NOTE: The MDP circuit for the PDU shall have an undervoltage device that automatically trips the breaker when the applied coil voltage drops to a specific percent of the rated value.

NOTE: The MDP circuit for the Shield Cooler Compressor Cabinet shall provide auto restart upon return of normal power to maximize proper uninterrupted magnet operation and to minimize cryogen consumption of the system.



WARNING

THE MDP CIRCUIT FOR THE SHIELD COOLER COMPRESSOR CABINET AUTO RESTART FUNCTION MUST BE CONTROLLED BY THE EMERGENCY OFF FUNCTION.

Main Disconnect Panel is to be located so the panel is visible to Power Distribution Unit (PD1) service personnel. Panel position above the floor must be per National Electric Code (NEC) 2005 or 2002 Article 404.8 or other national or local code.

A recommended method for providing a Main Disconnect Panel with multi-point remote control capability is shown in [Illustration 6-1](#).

Time delay fuses are recommended on the lines providing power to the protective disconnect device and must be rated according to the cable size. The circuit breaker ahead of the fuses must be capable of handling the magnetizing inrush current values of the Shield Cryo Cooler Compressor and transformer of the PDU module (PD1) in the HFD/PDU Cabinet (MR3).

Check local and national codes to determine if an interlock to the air-conditioning unit in the Equipment Room is required in the protective disconnect set-up.

The GE pre-engineered MDP option provides two Emergency Off buttons to be connected to the MDP to disable the power to all system equipment in emergency situations. Two Emergency Off buttons must be provided by the customer if GE pre-engineered MDP Option is not used. The Emergency Off buttons are to be mounted near each exit in the Magnet Room and Equipment Room at a height specified by local/national codes and connected to the protective disconnect device in order to disable the power to all MR system equipment in emergency situations. The Emergency Off buttons are to be clearly labeled "Emergency Off" and visible to personnel. It is important the buttons are labeled "off" and not "stop" since there exists an "Emergency Stop" button in the Signa system which powers down only a portion of system equipment for patient safety.

Customer supplied MDP must be lockable to meet OSHA requirements for power Lockout/Tagout requirements. The optional GE pre-engineered MDP provides for the disconnect of the facility power to the PDU, including the emergency off buttons, contacts for an interlock to the air-conditioning units in the Equipment Room, and the Shield Cooler Compressor Cabinet power circuit with auto restart and emergency off functions.

The MDP must be listed and labeled by a Nationally Recognized Testing Lab (NRTL) such as Underwriters Laboratory (UL) in accordance with 2002 National Electric Code (NEC) Article 110.2. The GE pre-engineered MDP option is UL labeled in accordance with 2002 National Electric Code (NEC) Article 110.2 The GE pre-engineered MDP is cUL and CE labelled. A customer designed and manufactured MDP labeling must bear the appropriate markings per local/national regulations.

NOTE: The maximum conductor the GE pre-engineered MDP can accept is #3/0 AWG (83 mm²). For feeders larger than 3/0 AWG (83 mm²) the wires must be reduced (ie. splice, junction box, etc.) to 3/0 AWG (83 mm²) within 10 feet (3 meters) of MDP. It is important to note the maximum cable wire from the MDP to the PDU must not be larger than 2/0 AWG (70 mm²).

Illustration 6-1: Protective Disconnect Setup For Type B Configuration

NOTE: RUNS 296 AND 297 ARE GE SUPPLIED CABLES. ALL OTHER WIRING IS CUSTOMER SUPPLIED. ALL EMERGENCY "OFF" BUTTONS ARE CUSTOMER SUPPLIED. **ALL OTHER WIRING IS CUSTOMER SUPPLIED.**

CIRCUIT BREAKER IS REQUIRED FOR SHIELD COOLER COMPRESSOR CABINET.

TWO REMOTE EMERGENCY "OFF" BUTTONS ARE SUPPLIED WITH GE MDP OPTION, **EMERGENCY OFF BUTTONS ARE CUSTOMER SUPPLIED IF GE MDP OPTION NOT USED .**

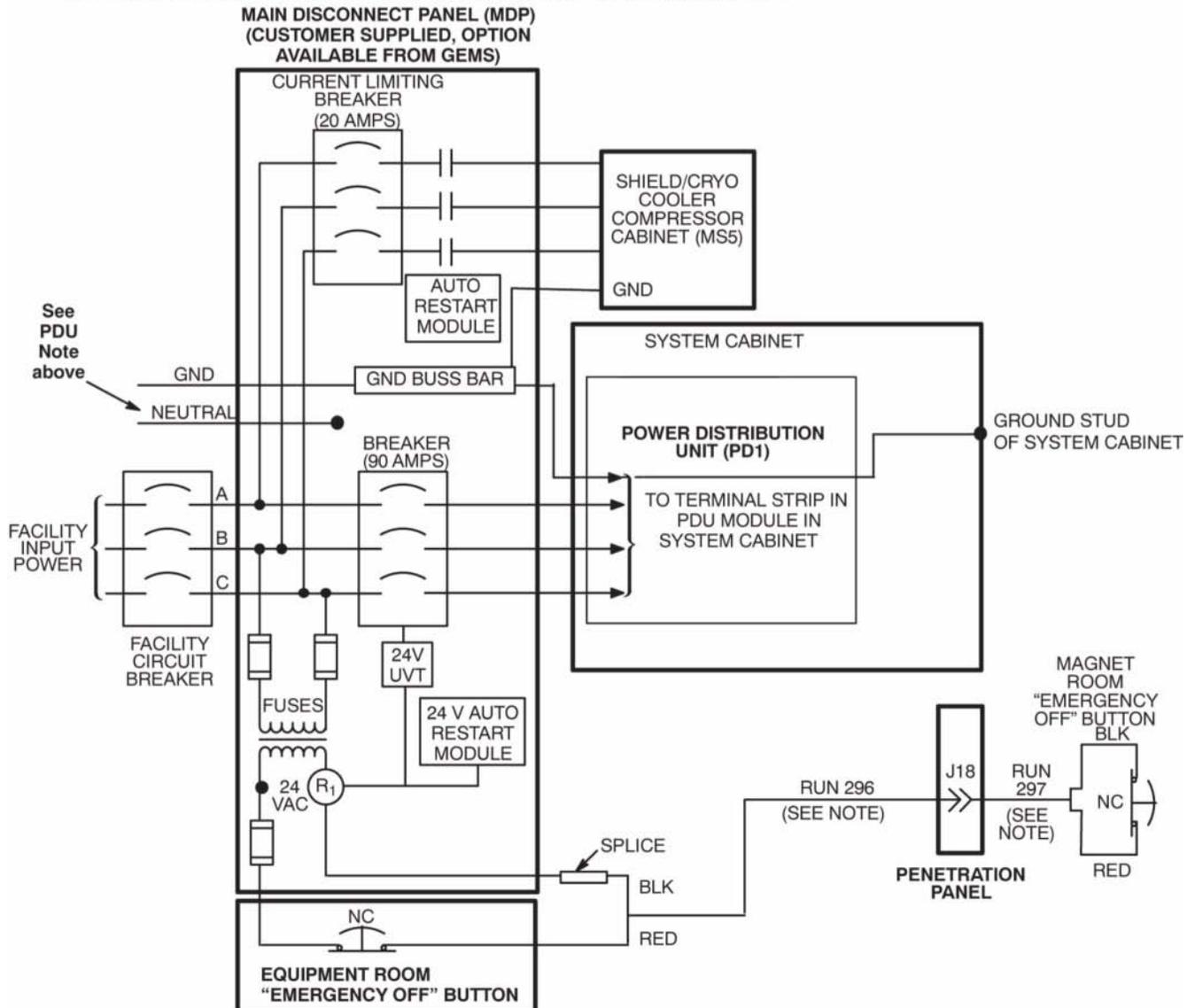
UNDERVOLTAGE DEVICE AUTOMATICALLY TRIPS PDU BREAKER WHEN COIL VOLTAGE DROPS TO A SPECIFIC PERCENT OF RATED VALUE, UNDERVOLTAGE TRIP (UVT).

AUTO RESTART CIRCUIT MUST START SHIELD COOLER COMPRESSOR AFTER ANY POWER OUTAGE.

EMERGENCY OFF CIRCUIT TRIPS PDU BREAKER & LOCKS OUT SHIELD COOLER.

PANEL MUST BE LISTED AND LABELED BY A NATIONALLY RECOGNIZED TESTING LAB (NRTL) SUCH AS UNDERWRITERS LABORATORY (UL) IN ACCORDANCE WITH NATIONAL ELECTRIC CODE (NEC) 2005 OR 2002 ARTICLE 110.2.

IF 3 PHASE WYE WITH NEUTRAL AND GROUND (5 WIRE SYSTEM) INPUT USED THEN NEUTRAL MUST BE TERMINATED INSIDE THE MAIN DISCONNECT CONTROL AND NOT BROUGHT TO THE SYSTEM CABINET



3.1.2 MDP for Type A

The GE pre-engineered MDP option provides multi-point remote control capability which is shown in [Illustration 6-2](#).

The design of the MDP shall incorporate an adjustable time delay auto restart control circuit for the MRCC, the Shield/Cryo Cooler Compressor Cabinet, and the single phase transformer for Magnet Monitor equipment (Magnet Monitor, optional UPS for Magnet Monitor, modem and the optional Multiplexer Box). The PDU shall not be included in the auto restart control circuit. Operation of any remote Emergency Off pushbutton MUST disable all MDP power and control circuits. LED pilot lights shall indicate system power status.

All control shall be low voltage. Power components shall be selected to provide type 2 coordination between overcurrent devices and all contactors. The 120 VAC supply receptacles for remotely mounted Magnet Monitor UPS (option) and Mux Box (option) must be included along with properly protected control power transformer. The 120 VAC UPS output power shall be connected back into the MDP for distribution to the Magnet Monitor and Modem. Operation of the previously mentioned Emergency Power Off pushbuttons shall disconnect and isolate the Magnet Monitor UPS output circuits from the Magnet Monitor and modem as well as disable the auto restart function.

The GE pre-engineered MDP consists of the following:

- A three-pole Main Circuit breaker rated for the total current of all the sub-breakers circuits. The short-circuit current interrupting rating of the breaker is 25,000 Amperes minimum or higher interrupting rating sufficient to interrupt the facility available short circuit current at its installed location per NEC 2002 Article 110.9.
- A three-pole circuit breaker rated for the current of the PDU circuit. The short-circuit current interrupting rating of the breaker is 25,000 Amperes minimum or higher interrupting rating sufficient to interrupt the facility available short circuit current at its installed location per NEC 2002 Article 110.9.
- A three-pole circuit breaker rated for the current of the Cryo Cooler Compressor Chiller (1st MRCC unit) circuit. The short-circuit current interrupting rating of the breaker is 25,000 Amperes to accommodate facility available short circuit current.
- A three-pole circuit breaker rated for the current of the Gradient Chiller (2nd MRCC unit) circuit. The short-circuit current interrupting rating of the breaker is 25,000 Amperes to accommodate facility available short circuit current.
- A three-pole circuit breaker rated for the current of the Shield/Cryo Cooler Compressor Cabinet circuit. The short-circuit current interrupting rating of the breaker is 25,000 Amperes to accommodate facility available short circuit current.
- A circuit to provide 120VAC single phase power to the Magnet Monitor, Modem, UPS for Magnet Monitor (optional), and Multiplexer Box (optional). The short-circuit current interrupting rating of the breaker is 25,000 Amperes to accommodate available fault current. The MDP includes a single phase step down transformer for 120VAC loads such as Magnet Monitor equipment (Magnet Monitor, optional UPS for Magnet Monitor, modem and the optional Multiplexer Box).
- The MDP Panel has receptacles inside the panel enclosure for connections of the UPS for Magnet Monitor input and output, Multiplexer Box, Magnet Monitor, and modem. The enclosure has provision for these cables to enter through the access panels in the bottom left side of the enclosure. Mounting of the panel must allow for 5-6 inch (127-152 mm) of free space to allow for cable bending and installation. Strain relief bushings are provided with the individual equipment for each of these cables, not provided with the MDP.

The MDP is to be located so the top of the upper circuit breaker handle when in the ON position does not exceed 79 inches (2000 mm) from the floor and visible to Power Distribution Unit (PD1), MRCC or its RCP, Shield/Cryo Cooler Compressor Cabinet, and the service personnel. The optional UPS for the Magnet Monitor may be located below the MDP if sufficient space is available or adjacent if sufficient space is not available.

NOTE: The GE pre-engineered MDP circuits for the MRCC, the Shield/Cryo Cooler Compressor Cabinet, and the single phase transformer for Magnet Monitor equipment (Magnet Monitor, optional UPS for Magnet Monitor, modem and the optional Multiplexer Box) have auto restart upon return of normal power after a time delay of 3 to 30 seconds (field adjustable) to minimize cryogen consumption of the system. The MDP Emergency Off circuit turns off power to all branch circuits including the Magnet Monitor UPS option output and turns off the auto restart function.

NOTE: The PDU circuit has low voltage release feature which disconnects power from the PDU upon the first loss of power. Power to the PDU is not restored automatically after a power interruption. Emergency Off operation disconnects power from all circuits including the PDU.

The circuit breakers or fuses ahead of the MDP must be capable of handling the magnetizing inrush currents of the Coldhead MRCC, Gradient MRCC, Shield/Cryo Cooler Compressor, Magnet Monitor equipment, and transformer of the PDU module (PD1) in the ACGD/PDU Cabinet (MR3). If fuses are used time delayed fuses are recommended.

Check local and national codes to determine if an interlock to the air-conditioning unit in the Equipment Room is required in the protective disconnect set-up.

The GE pre-engineered Twin MDP option provides two Emergency Off buttons to be connected to the MDP to disable the power to all system equipment in emergency situations. Two Emergency Off buttons must be provided by the customer if GE pre-engineered Twin MDP Option is not used. The Emergency Off buttons are to be mounted near each exit in the Magnet Room and Equipment Room at a height specified by local/national codes and connected to the protective disconnect device in order to disable the power to all MR system equipment in emergency situations. The Emergency Off buttons are to be clearly labeled "Emergency Off" and visible to personnel. It is important the buttons are labeled "off" and not "stop" since there exists an "Emergency Stop" button in the Signa system which powers down only a portion of system equipment for patient safety.

NOTE: The emergency off circuit disconnects power to the PDU, MRCC, Shield/Cryo Cooler Compressor Cabinet, the single phase 120V transformer output and optional UPS (if purchased) for Magnet Monitor equipment. Power can be restored to the MDP outputs by pressing the MAIN POWER ON pushbutton on the MDP for the MRCC, Shield/Cryo Cooler Compressor Cabinet, Magnet Monitor equipment (Magnet Monitor, optional UPS for Magnet Monitor, modem and the optional Multiplexer Box). Power to the PDU is restored by pressing the PDU POWER ON pushbutton and also requires pressing the EMO Reset button on the PDU.

The MDP must be lockable to provide for single point power Lockout/Tagout requirements. The MDP provides for the disconnection of the facility power to the PDU, MRCC, and Shield/Cryo Cooler Compressor Cabinet. Individual branch circuits for the PDU, Magnet Monitor equipment,

MRCC, and Shield/Cryo Cooler Compressor Cabinet must be lockable circuit breakers. The GE pre-engineered MDP has lockable GE Spectra circuit breakers and also has electrical contacts for an interlock to the air-conditioning units in the Equipment Room. Check local and national codes to determine if an interlock to the air-conditioning unit in the Computer/Equipment Room is required in the protective disconnect set-up.

The MDP must be listed and labeled by a Nationally Recognized Testing Lab (NRTL) such as Underwriters Laboratory (UL) in accordance with 2002 National Electric Code (NEC) Article 110.2. The GE pre-engineered MDP option is UL labeled in accordance with 2002 National Electric Code (NEC) Article 110.2 The GE pre-engineered MDP is cUL and CE labelled. A customer designed and manufactured MDP labeling must bear the appropriate markings per local/national regulations.

NOTE: The maximum conductor the GE pre-engineered MDP can accept is #3/0 AWG (83 mm²). For feeders larger than 3/0 AWG (83 mm²) the wires must be reduced (ie. splice, junction box, etc.) to 3/0 AWG (83 mm²) within 10 feet (3 meters) of MDP. It is important to note the maximum cable wire from the MDP to the PDU must not be larger than 2/0 AWG (70 mm²).

Illustration 6-2: Protective Disconnect Setup For Type A Configuration

NOTE: RUNS 296 AND 297, & POWER CORDS FOR SHIELD/CRYO COOLER COMPRESSOR CABINET, MRCC, & MAGNET MONITOR EQUIPMENT (MAGNET MONITOR, UPS INPUT & OUTPUT, MODEM, OPTIONAL MULTIPLEXER) ARE GE SUPPLIED CABLES. **ALL OTHER WIRING IS CUSTOMER SUPPLIED.**

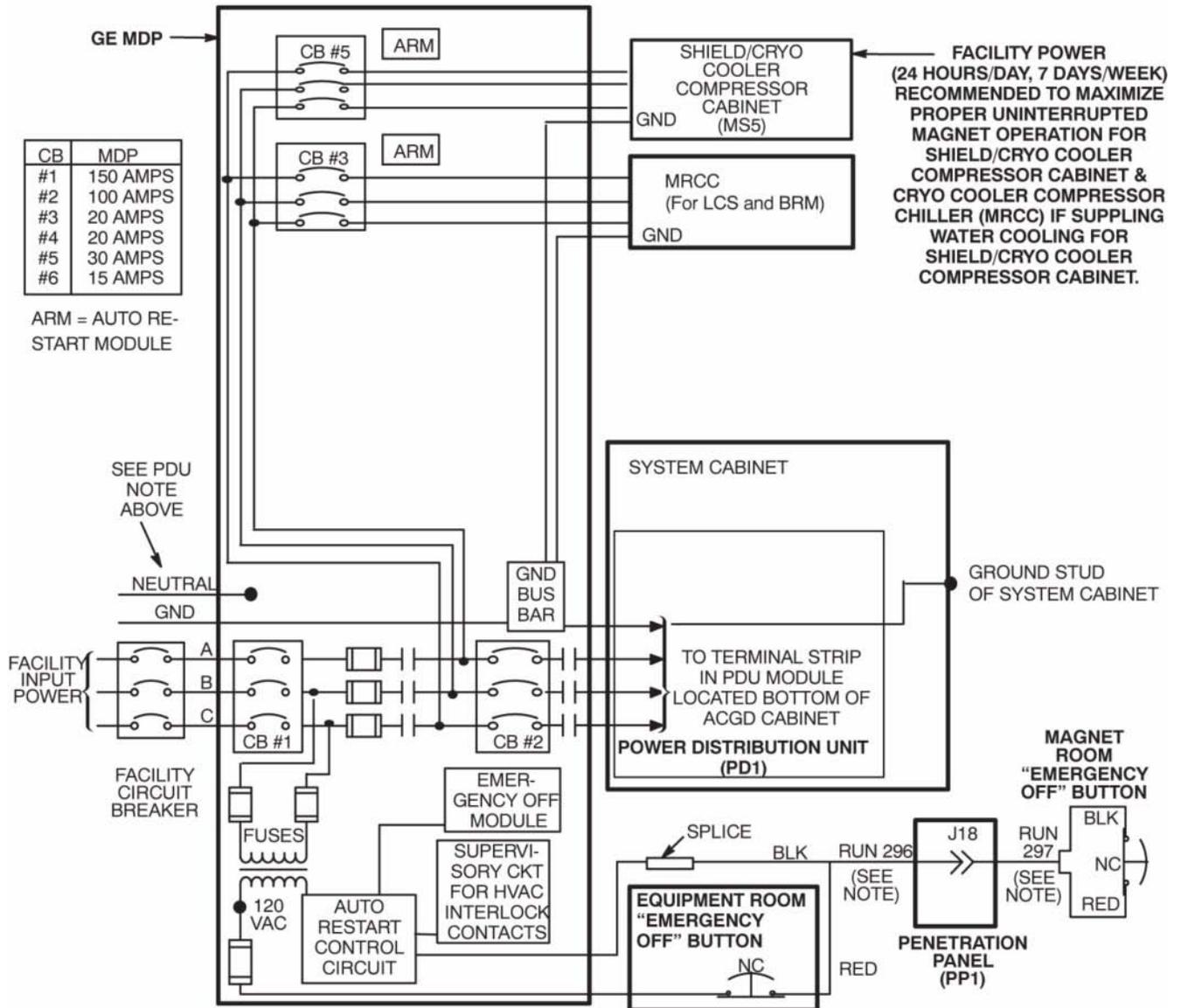
TWO REMOTE EMERGENCY "OFF" BUTTONS ARE SUPPLIED WITH GE MDP OPTION, **EMERGENCY OFF BUTTONS ARE CUSTOMER SUPPLIED IF GE MDP OPTION NOT USED.**

CIRCUIT BREAKERS ARE PROVIDED FOR PDU, CRYO COOLER COMPRESSOR CHILLER, GRADIENT CHILLER, SHIELD/CRYO COOLER COMPRESSOR CABINET, MAGNET MONITOR EQUIPMENT CIRCUITS.

ALL BRANCH CIRCUITS DROP OUT ON LOSS OF POWER. COLDHEAD MRCC, GRADIENT MRCC, SHIELD/CRYO COOLER COMPRESSOR CABINET, & MAGNET MONITOR EQUIPMENT AUTOMATICALLY RESTART AFTER 3 SEC TIME DELAY UPON RESTORATION OF POWER. EMERGENCY OFF LOCKS OUT ALL CONTACTORS.

IF 3 PHASE WYE WITH NEUTRAL AND GROUND (5 WIRE SYSTEM) INPUT USED THEN NEUTRAL MUST BE TERMINATED INSIDE THE MAIN DISCONNECT PANEL AND NOT BROUGHT TO THE POWER CABINET

SUPERVISORY CIRCUIT FOR HVAC INTERLOCK CONTACTS OPEN ON LOSS OF DC POWER OR EMERGENCY OFF OPERATION.



3.2 System Power Distribution Unit

The PDU Module in the lower portion of HFD/PDU Cabinet has an integrated filter for a level of power conditioning. The largest allowable phase conductor the PDU will accept is 3/0 AWG (83 mm²). Larger feeder wires can be connected to the MDP with 3/0 AWG (83 mm²) between the MDP and PDU.

NOTE: The ground conductor between the MDP and PDU shall be minimum size of 1/0 AWG copper or the same size as the feeder wire, which ever is larger. Lug connector for the ground wire is to be provided by the contractor, recommended Amp Inc. number 36919 lug.

NOTE: The resistance between any two grounded devices in the MR system must not exceed 0.1 ohm (ie. PDU and MDP).

NOTE: Neutral, if present, must be terminated prior to or inside the Main Disconnect Panel and not brought to the PDU Module in the lower portion of HFD/PDU Cabinet (MR3).

NOTE: When the full MR system UPS option [Signature 5000 Series 3 UPS 100KVA (E4502FB)] is installed the feeder wiring from the UPS to the PDU Module must be sized to maintain voltage regulation of <5% at 100KVA.

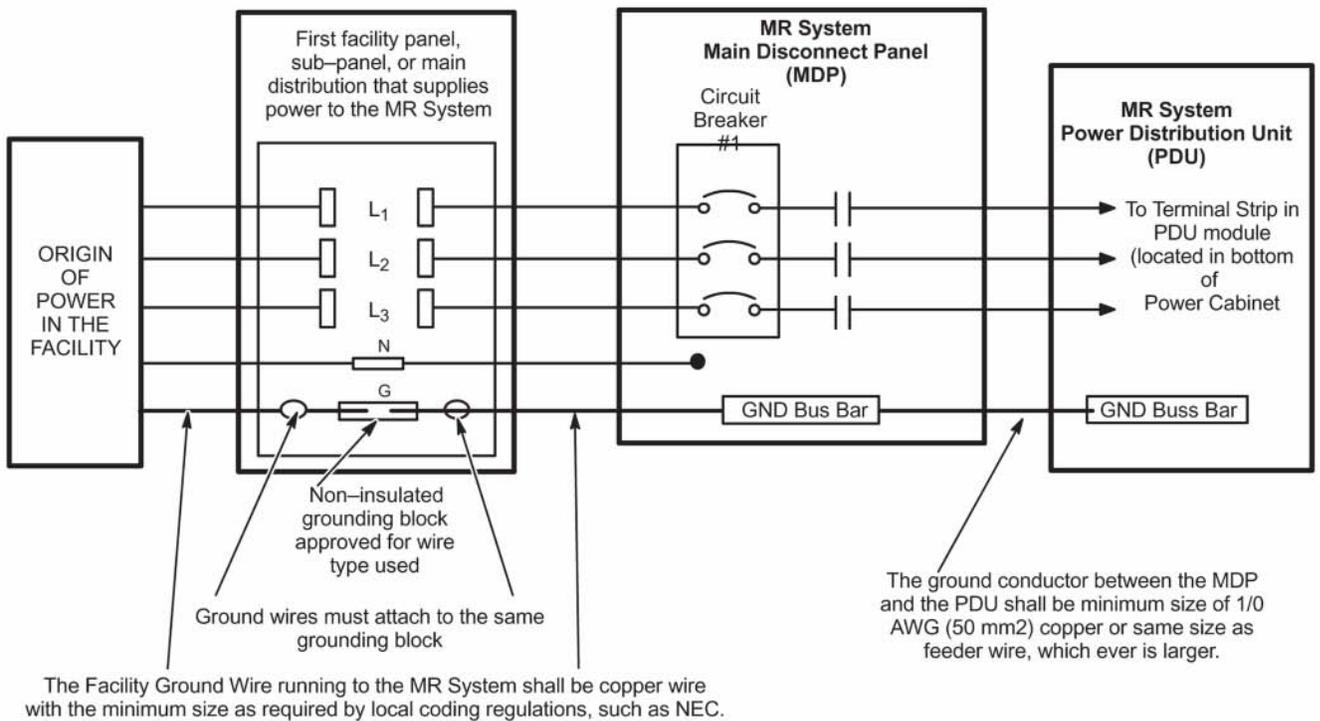
4 Grounding

4.1 Facility Ground

The ground for the MR system shall originate at the system power source, ie. transformer or first access point of power into the facility, and be continuous to the MR system Main Disconnect Panel (MDP) in the room. This ground can be spliced with "High Compression Fittings" and should be terminated at each distribution panel it passes through. When it is broken for a connection to a panel, it shall be connected into an approved non-insulated grounding block with the incoming and outgoing ground in this same grounding block, which is then connected to the steel panel, never using the steel or other material of the panel as the block. See [Illustration 6-3](#).

The connection at the power source shall be at the grounding point of the "Neutral - Ground" if a "Wye" transformer is used, or typical grounding points of separately derived system. In the case of an external facility, it shall be bonded to the facility ground point at the service entrance.

Illustration 6-3: Ground Wire To MR System & Ground Connection At Distribution Panel



Ground Wire

The main facility ground conductor to the MDP shall be copper wire and the minimum size as required by the local coding regulations, such as the NEC. A dedicated copper ground wire the same size as the feed wires or 1/0 AWG (which ever is larger) must be run from the MR system MDP to the PDU. See [Illustration 6-3](#). The ground wire impedance from the MR system disconnect, including the ground rod, shall not have an impedance greater than 2 ohms to earth as measured by one of the applicable techniques described in Section 4 of ANSI/IEEE Standard 142 - 1982 which can be accomplished using 3-point Fall Of Potential (3 point measurement) method or

Clamp-On Ground Resistance measurement which requires a ground measurement device such as AEMC 3730.

4.2 System Ground

The MR system is designed with minimum ground loops to prevent noise currents and natural disturbances from flowing through the low-level signal reference path.

The three major grounding points in the MR system are: the system ground point in the System Cabinet, Ground Stud of System Cabinet (Scan Room Side), the enclosure ground points (ground studs located in each cabinet or enclosure), and the RF shielded room common ground point (If available). Refer to [Chapter 8, Electrical](#) for a further description of the RF shielded room common ground point.

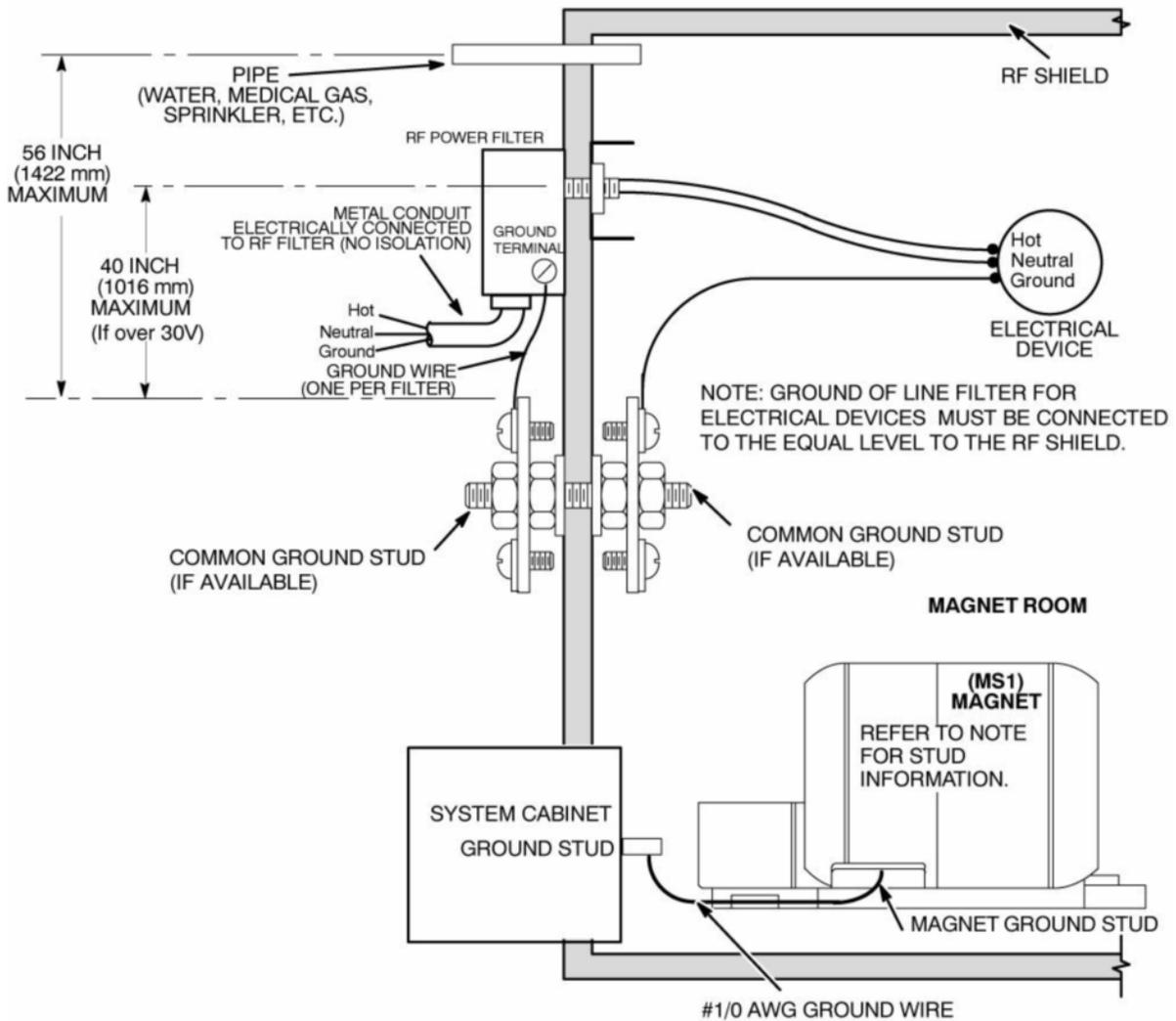
To ensure patient safety and system performance, the conditions defined in [Illustration 6-4](#) must be met when running power lines into the Magnet Room.

Any modifications or non-MR equipment grounds added to the MR ground system must be approved by your GE Service Representative in order to ensure safety and performance.

Illustration 6-4: MR Magnet Room Grounding Requirements And Typical Diagram

Note:

1. All items shown are customer supplied except System Cabinet, Magnet, and #1/0 AWG Ground Wire between System Cabinet Ground stud and Magnet Ground stud.
2. Resistance between any two grounded devices must not exceed 0.1 ohm to ensure equal potential ground system within the Magnet Room.
3. RF Power Filters over 30 volts must be located within 40 in. (1016 mm) of the RF Common Ground Stud.
4. RF Power Filters of 30 volts or less may be located anywhere on the RF Shield.
5. All metallic pipes (including water, medical gas, sprinklers, etc.) entering the RF Shield, excluding the Cryogenic Vent and floor drains, must be located within 56 inches (1422 mm) of the RF Common Ground Stud.
6. All electrical devices (e.g., outlets, light fixtures, etc.) must have a ground wire from device power source and be grounded to the RF Shield at the RF Common Ground Stud.
7. One #1/0 AWG Ground Wire to be connected to only one ground stud on Magnet Foot or Cryostat.
8. Do not ground non-MR equipment to the MR ground system.
9. The illustration below shows a typical ground layout.



5 Ground Fault Protection

MR suites and radiology departments are considered health care facilities pursuant to National Electric Code (NEC) 2005 or 2002 Article 517.2 definitions and as such must be powered from sources that comply with the ground fault requirements of NEC Article 517.17. NEC 2005 Article 517.17 (B) or NEC 2002 Article 517.17 (A) states "Where ground fault is required for the operation of the service disconnecting means or feeder disconnecting means as specified in NEC 2002 Article 230.95 or 215.10, an additional step of ground fault protection shall be provided in the next level of feeder disconnecting means downstream towards the load."

NEC 2005 or 2002 Article 230.95 or 215.10 requires ground fault protection on service disconnecting means rated 1000 Amps or more on solidly grounded WYE services over 150 volts to ground but not over 600 volts phase to phase.

The two or more levels of ground fault shall be coordinated to provide selectivity between each level of ground fault such that a ground fault on the load side of the feeder would cause the feeder and not the service disconnect to open on a ground fault. Six cycles of separation between the different levels of ground fault tripping is required for the system to be considered selective in accordance with NEC 2005 Article 517.17 (B) or NEC 2002 Article 517.17(B).

Check national and local electrical codes.

6 Power Source Monitoring

The facility input power for the proposed system should be checked using a power line disturbance monitor for average line voltage, surges-sags, impulses, and frequency. Some of the recommended line analyzers which are designed for unattended monitoring are the Dranetz Models 656A or 658 and RPM Models 1651, 1656, or 1658.

Analysis should span a period to include two weekends so as to cover several days of normal use. The possibility of "brown-out" conditions which may be experienced in summer must be considered. Any existing power problems with large power consuming systems (x-ray units, CT scanners, etc.) or other computer installations at the proposed site should be reviewed as they may affect the MR system. Results of this analysis should be reviewed with your GE representative to determine if line conditioning is needed.

7 Emergency Power

Primary power should be distributed from the customer's emergency life-safety power branch to an emergency lighting source in the Magnet Room. All input power lines must be filtered upon entrance into the RF shielded room (Magnet Room) and grounded according to the requirements listed under System Grounding heading in [Grounding](#). Always check national and local codes for other emergency power requirements.

8 DC Lighting Controller (Facility Option)

Direct current (DC) powered lighting is recommended in the Magnet Room per [Chapter 5, Lighting](#). A constant lighting level DC Light Controller is available from GE as well as a variable DC lighting controller system. The wiring diagrams for these units are shown in [Illustration 6-5](#) and [Illustration 6-6](#). The input power, interconnect cabling, RF shielded room filters, lighting fixtures, and conduit are customer furnished.

The DC lighting systems output is rated nominally 115 VDC. Determining whether the 20 or 28 Amp system is required can be calculated by: $I = \text{Total Lamp Wattage} \div 115V$. If $I \leq 20$ then a 20 Amp system can be used. If $I \geq 20$ but < 28 then use the 28 Amp system.

Illustration 6-5: DC Lighting Controller (Facility Option) Wiring Diagram

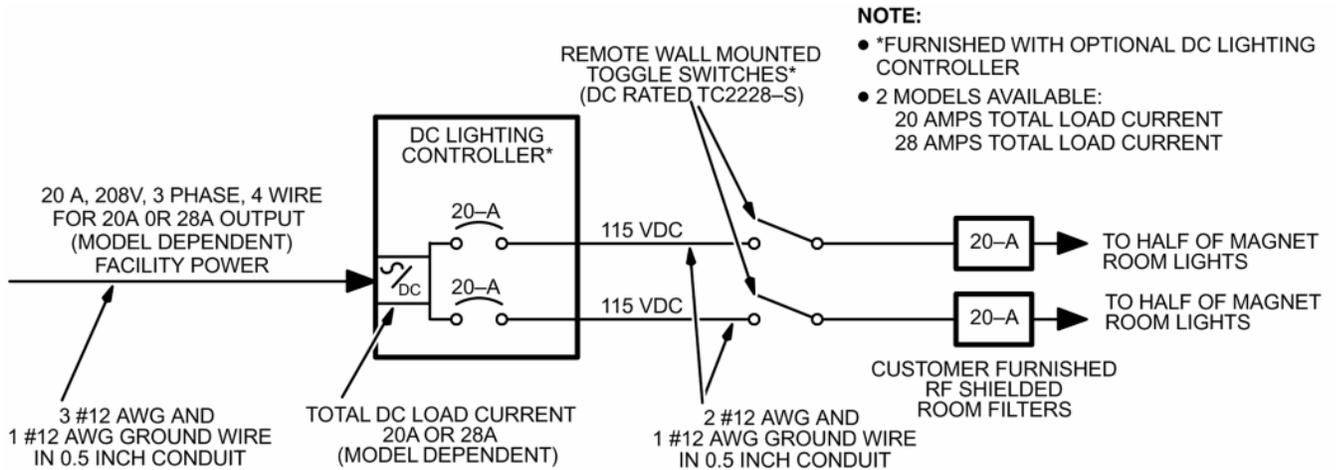
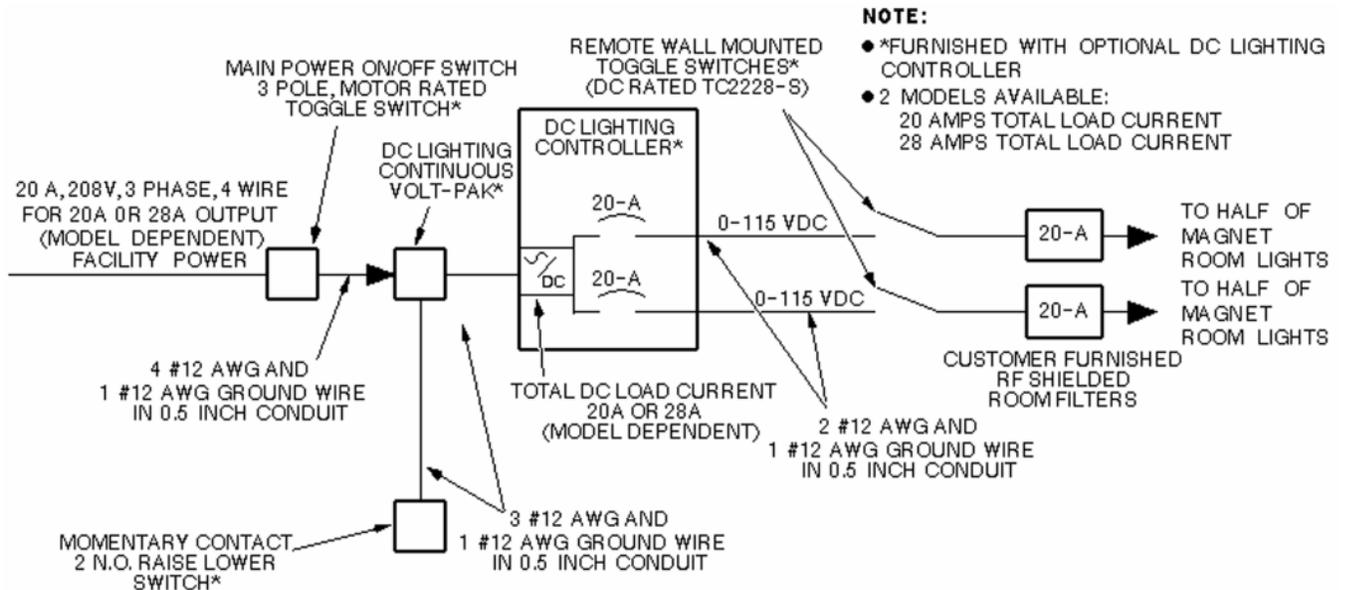


Illustration 6-6: Variable DC Lighting Controller (Facility Option) Wiring Diagram



This page left intentionally blank.

Chapter 7 Interconnect Data

1 Introduction



NOTICE

During MR installation, some power cables and ground cables may be provided by customer. On installation sites in China, please make sure that the power cables and ground cables provided by customers have China Compulsory Certification (CCC).

System and interconnects Installation must be in accordance with local and national code.

This chapter addresses cable interconnections and customer supplied components for the system. It's subsections are broken down as follows:

- *Introduction*: defines overall system interconnects cable groups and component designations
- [Power Interconnects](#): overview of cable connections to the system Main Disconnect Panel and Power Distribution Unit, subsystem power distribution
- [Emergency Off Wiring](#): wiring to main disconnect for emergency off
- System Interconnects:
 - [Signa Cable Groups Length Provided](#): Lists the cable group lengths provided by the cable catalogs
 - [L1 Interconnects](#): Interconnects Within Magnet Room details
 - [L2 Interconnects](#): Interconnects Between PP1 & Components In Equipment Room details
 - [L1 / L2 Interconnects](#): Interconnects Shared Between Magnet Room & Equipment Room Through PP1 details
 - [L3 Interconnects](#): Interconnects Between Components Within Equipment Room details
 - [L4 Interconnects](#): Interconnects Between OW & PP1 details
 - [L5 Interconnects](#): Interconnects Between OW & Components In Equipment Room details
 - [Customer Supplied Interconnects](#): Lists interconnects that are to be provided by the customer
 - [Cable Group and Location Cross Reference](#): contains a table of all the cable group numbers for the system cross referenced to Locations
- MRCC Additional Interconnects: additional system cable interconnects for each of the MRCC site configurations
 - [Interconnects For MRCC Option Located Outdoors](#)
- [Contractor Furnished Components](#): miscellaneous components typically provided by a customer contractor
- [Oxygen Monitor Option Interconnects](#) lists interconnects for the Oxygen Monitor Option

1.1 Component Designators

GE uses a Component Designator System as a means of identifying system components in a consistent manner. All subsystem cabinets and other components are referred to by their component designators in the diagrams and tables of the Interconnect Data sections.

Refer to [Table 7-1](#) for all component designators.

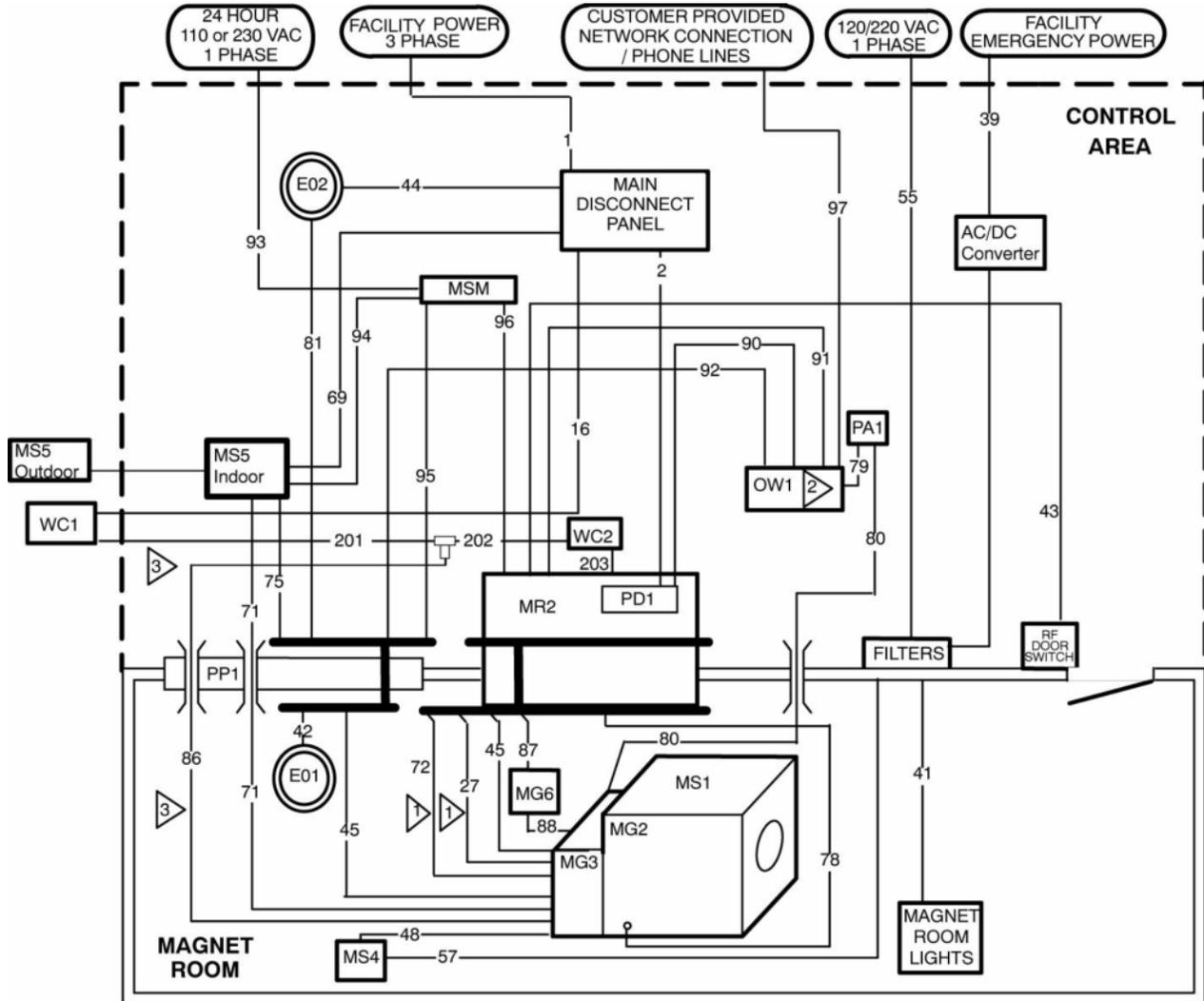
Table 7-1: Signa HDe 1.5T Component Designation

Basic System Or Option	Component Designator	Description
Basic System	EO1/EO2	Emergency Off Buttons
	MDP	Main Disconnect Panel
	MG2	Magnet Enclosure
	MG3	Magnet Rear Pedestal
	MG6	Blower Box
	MR2	System Cabinet
	MS1	Superconducting Magnet
	MS4	Magnet Rundown Unit
	MS5	Shield/Cryo Cooler Compressor Cabinet
	MSM1	Magnet Monitor
	OW1	Operator Workspace
	PD1	Power Distribution Unit (PDU) is a module in lower portion of HFD/PDU Cabinet
	PA1	Pneumatic Patient Alert Control Box
	PP1	Penetration Panel
	PT1	Patient Transport Table
WC1	Water Chiller for BRM	
WC2	Water Chiller for System Cabinet	
Option	OM1	Oxygen Monitor
	OM3	Remote Oxygen Sensor Module

1.2 Group Interconnects

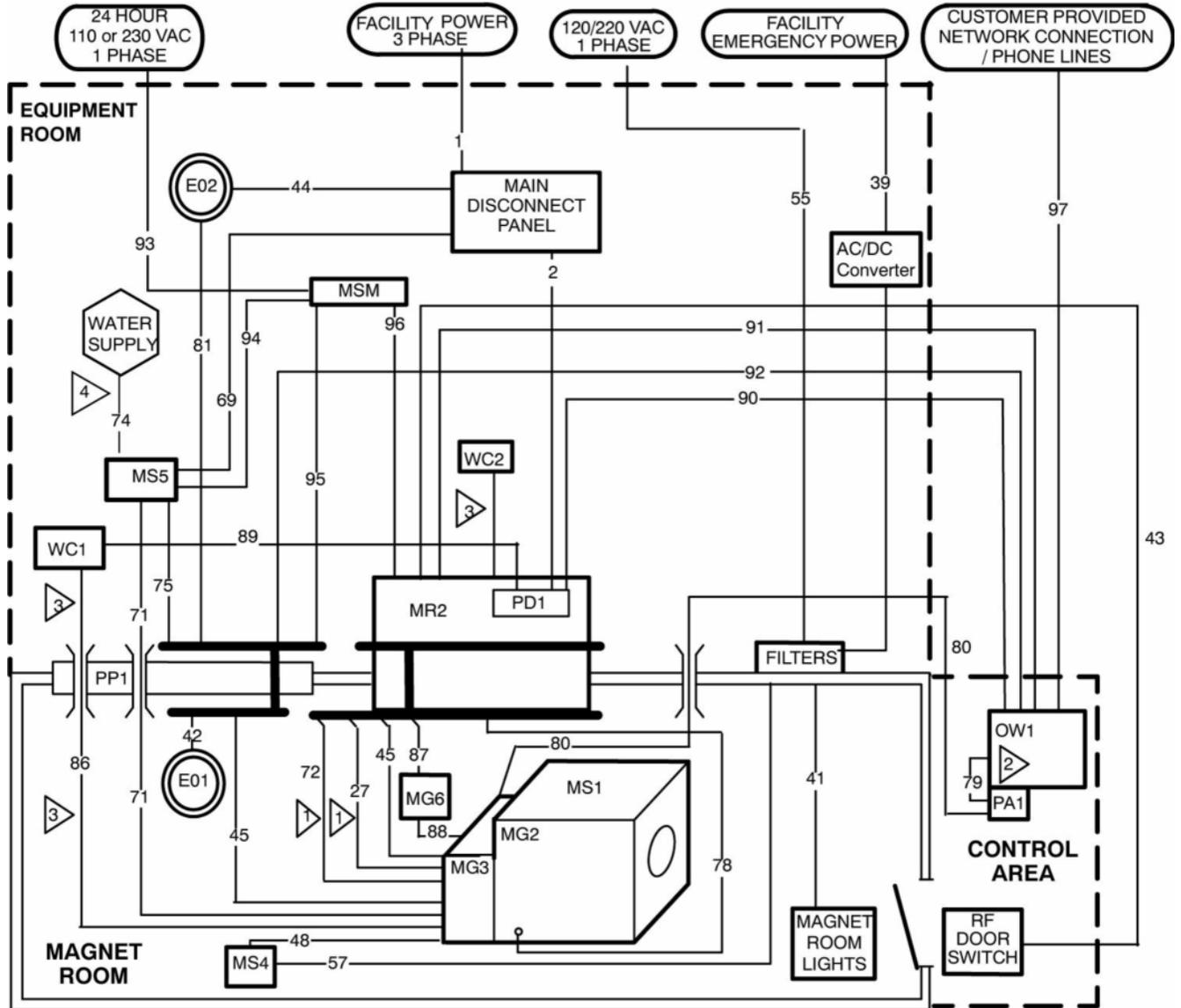
[Illustration 7-1](#) shows the Group Interconnect Diagram for the Signa system. Each group contains one or more cables. This diagram should be referred to when using the tables in this chapter.

Illustration 7-1: Signa Group Interconnect Diagram (Type A)



- 1 MUST BE CUT AND CONNECTED TO PP1 AT SITE.
 NOTE: IMPEDANCE IS NOT CRITICAL SO EXCESS CABLE SHOULD BE CUT OFF.
- 2 OPERATOR WORKSPACE (OW1) SUBSYSTEM EQUIPMENT IS PROVIDED WITH MAXIMUM LENGTH CABLES POSSIBLE. SEVERAL OW ASSEMBLIES ARE MOUNTED TO OW TABLE & OW INTERCONNECTS ARE ROUTED THROUGH TABLE CABLE TRAY. FOR REFERENCE USE ONLY THE OW1 RUN NUMBERS FOR LINUX PC ARE 1059, 1060, 1061, 1062, 1063, 1064, 1065, 1066, 1067, 1068, 1069, 1070, 1071, 1074, 1075 AND FOR OCTANE COMPUTER ARE 049, 792, 793, 794, 795, 796, 797, 798, 799, 806, & 807.
- 3 THIS GROUP CONTAINS WATER LINES WHICH SHALL BE ROUTED SEPARATE FROM ELECTRICAL LINES (I.E POWER AND SIGNAL)

Illustration 7-2: Signa Group Interconnect Diagram (Type B)



- 1 MUST BE CUT AND CONNECTED TO PP1 AT SITE.
 NOTE: IMPEDANCE IS NOT CRITICAL SO EXCESS CABLE SHOULD BE CUT OFF.
- 2 OPERATOR WORKSPACE (OW1) SUBSYSTEM EQUIPMENT IS PROVIDED WITH MAXIMUM LENGTH CABLES POSSIBLE. SEVERAL OW ASSEMBLIES ARE MOUNTED TO OW TABLE & OW INTERCONNECTS ARE ROUTED THROUGH TABLE CABLE TRAY. FOR REFERENCE USE ONLY THE OW1 RUN NUMBERS FOR LINUX PC ARE 1059, 1060, 1061, 1062, 1063, 1064, 1065, 1066, 1067, 1068, 1069, 1070, 1071, 1074, 1075 AND FOR OCTANE COMPUTER ARE 049, 792, 793, 794, 795, 796, 797, 798, 799, 806, & 807.
- 3 THIS GROUP CONTAINS WATER LINES WHICH SHALL BE ROUTED SEPARATE FROM ELECTRICAL LINES (I.E POWER AND SIGNAL)
- 4 For Water Cooled Compressor only.
 THIS GROUP CONTAINS WATER LINES WHICH SHALL BE ROUTED SEPARATE FROM ELECTRICAL LINS (I.E. POWER & SIGNAL)

NOTE: For Groups 4, 10, 15, 16, 21, 50, 51, 74, & 86 for configuration appropriate interconnects and details refer to [Interconnects For MRCC Option Located Outdoors](#).

1.3 Definition of Terms

The definition of terms used in the interconnects details tables throughout this chapter are:

L1 (Location 1)

Location of interconnects between Penetration Panel (PP1) and components in Magnet Room and Within Magnet Room between components

L2 (Location 2)

Location of interconnects between Penetration Panel (PP1) and components in Equipment Room

L1/L2 (Location 1 / Location 2)

Location of interconnects between Magnet Room and Equipment Room components, includes interconnects routed through PP1 waveguides and interconnects which length provided is cut at site and shared between Magnet and Equipment Rooms

L3 (Location 3)

Location of interconnects between components within Equipment Room

L4 (Location 4)

Location of interconnects between Operator Workspace (OW) and PP1

L5 (Location 5)

Location of interconnects between OW and components in Equipment Room

Cable Length

Refer to [Cable Group Length Provided](#) for cable groups specific length provided by each catalog.

Usable Length

Amount of cable/wire/hose/etc. available for site routing point to point of the FROM and TO equipment. The interconnect cable/wire/hose total length MINUS any required takeup at or within both the FROM and TO equipment determines the usable length.

Group Number

Identifying number referenced to bundles (i.e. groups) of cables as shown in [Illustration 7-1](#)

Area

Cross-sectional area of the combined cables in a group.

NOTE: The group area was found by adding up the circular cross-sectional areas of all individual cables within a group. It does not take any fill factors or space between cables into account. Adhere to applicable electrical codes for fill factors.

Between Units (From/To)

Component Designators as found in interconnects list tables throughout this chapter, refer to [Table 7-1](#) for designators descriptions.

Run Number

Unique number assigned to each GE-supplied cable.

NOTE: The Run Number must be used when making special cable order inquiries.

Cable Diameter

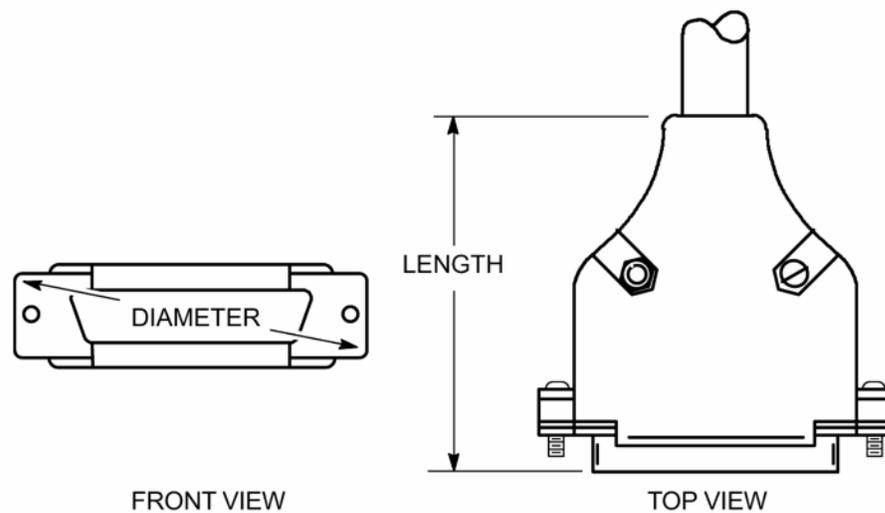
Diameter of an individual cable

Plug Pulling Diameter x Length

Cable plug dimensions as shown in [Illustration 7-3](#)

NOTE: In some cases, a cable has more than one connector on an end. These cables will have the number of connectors following the english dimensions of the plug pulling diameter times length (e.g. '2.0x3.25 -x2' means there are 2 connectors with dimensions of 2.0 in. diameter and 3.25 in. length). Of course, the same number of connectors apply to the metric dimensions as well.

Illustration 7-3: Subminiature-D Connector Plug Pulling Dimensions



2 Power Interconnects

The interconnects for the MDP include:

- Facility Main power; refer to [Chapter 6, System Power Introduction](#) and [Chapter 6, Critical Power Requirements](#) for detailed information on main power connections.
- Main power between the system Main Disconnect Panel (MDP) and Power Distribution Unit (PD1).
- NOTE:** The PDU is a module (PD1) in the lower portion of the System Cabinet (MR2).
- Emergency off wiring; refer to [Emergency Off Wiring](#) for information on the emergency off circuit interfacing.
- Shield/Cryo Cooler Compressor Cabinet (MS5)

- System Cooling Cabinet, for power interconnect details refer to the appropriate configuration:
 - [Interconnects For MRCC Units Located Outdoors](#)

- Magnet Monitor equipment

The interconnects for the PD1 include:

- Power cables GE supplied subsystems for Operator Workspace, System Cabinet.
- 1 system ground cable to RF Common Ground Stud at the Penetration Panel
- 1 auxiliary ground cable to System Cabinet
- 1 control cable PD1 to System Cabinet

Conduit or pipe is not recommended for cable runs since the system uses many prefabricated cables with large connectors. Power cables may be pulled by the lug terminal ends so the connector pulling dimensions on the plug ends will not be a factor for routing power cables.

NOTE: The power cables will probably need to be terminated at PD1 located in the lower portion of the System Cabinet if conduit is used.

Unless otherwise specified, cables and components listed in the following subsections are supplied by GE.

3 Emergency Off Wiring

3.1 Introduction

This section addresses wiring for the Emergency Off circuit (also known as protective disconnect circuit). Refer to [Chapter 6, Main Disconnect Panel \(MDP\)](#) for information on the recommended protective disconnect device and emergency off button locations and mounting.

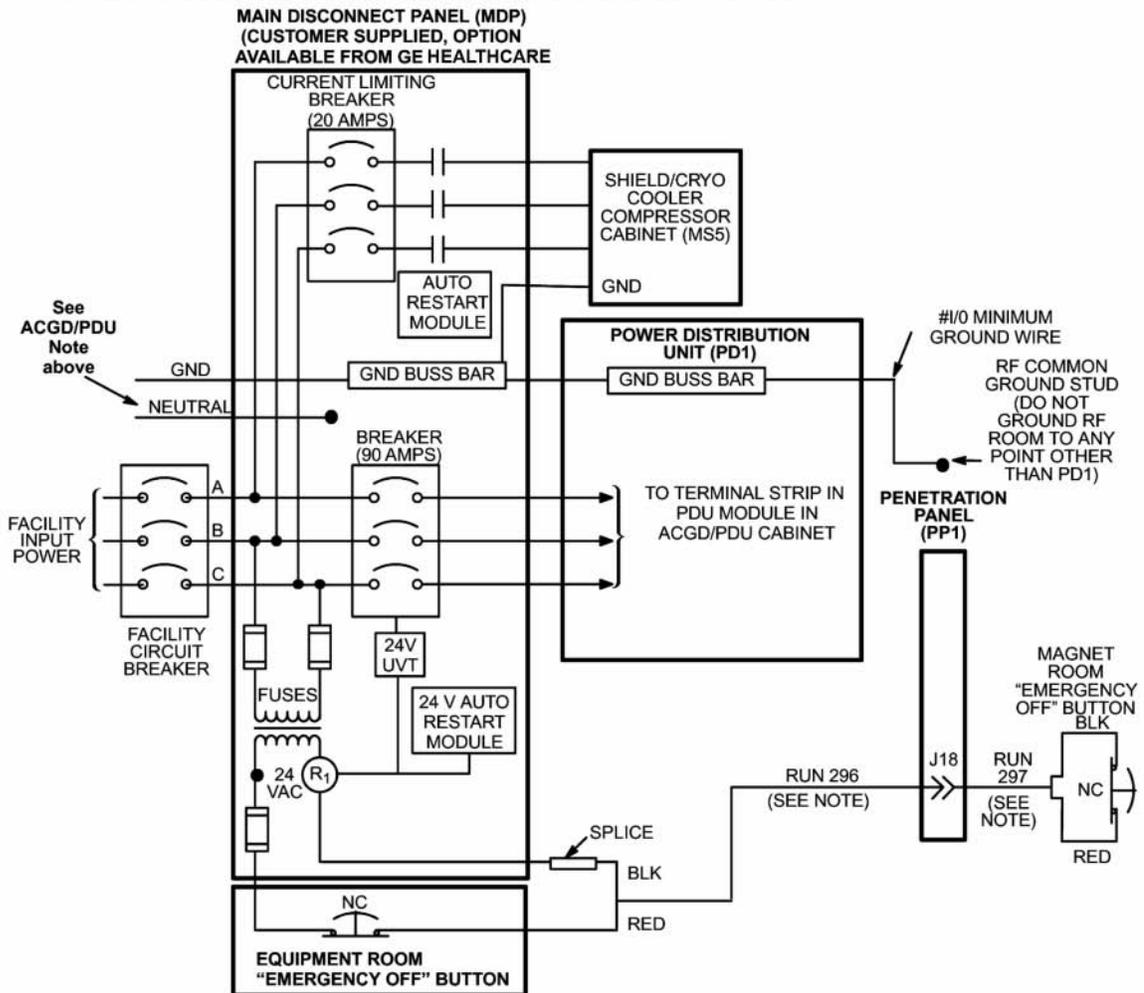
The emergency off wiring for the MR system is unique because the wiring into the magnet room must be RF tight.

3.2 Main Disconnect Panel Connections

The emergency off circuit is shown in [Illustration 7-4](#). The circuit utilizes the normally closed series loop shown. The GE pre-engineered MDP Option provides 2 emergency off buttons.

Illustration 7-4: Protective Disconnect Set-Up

- NOTE:**•RUNS 296 AND 297 ARE GE SUPPLIED CABLES. ALL OTHER WIRING IS CUSTOMER SUPPLIED. ALL EMERGENCY "OFF" BUTTONS ARE CUSTOMER SUPPLIED. **ALL OTHER WIRING IS CUSTOMER SUPPLIED.**
- CIRCUIT BREAKER IS REQUIRED FOR SHIELD COOLER COMPRESSOR CABINET.
 - TWO REMOTE EMERGENCY "OFF" BUTTONS ARE SUPPLIED WITH GE MDP OPTION, **EMERGENCY OFF BUTTONS ARE CUSTOMER SUPPLIED IF GE MDP OPTION NOT USED**.
 - UNDERVOLTAGE DEVICE AUTOMATICALLY TRIPS PDU BREAKER WHEN COIL VOLTAGE DROPS TO A SPECIFIC PERCENT OF RATED VALUE, UNDERVOLTAGE TRIP (UVT).
 - AUTO RESTART CIRCUIT MUST START SHIELD COOLER COMPRESSOR AFTER ANY POWER OUTAGE.
 - EMERGENCY OFF CIRCUIT TRIPS PDU BREAKER & LOCKS OUT SHIELD COOLER.
 - PANEL MUST BE LISTED AND LABELED BY A NATIONALLY RECOGNIZED TESTING LAB (NRTL) SUCH AS UNDERWRITERS LABORATORY (UL) IN ACCORDANCE WITH NATIONAL ELECTRIC CODE (NEC) 2005 OR 2002 ARTICLE 110.2.
 - IF 3 PHASE WYE WITH NEUTRAL AND GROUND (5 WIRE SYSTEM) INPUT USED THEN NEUTRAL MUST BE TERMINATED INSIDE THE MAIN DISCONNECT CONTROL AND NOT BROUGHT TO THE ACGD/PDU CABINET



3.3 Magnet Room Wiring

GE provides two cables for routing the emergency off circuit through the Penetration Panel and into the magnet room (Runs 296 and 297). Alternate wiring may be used by the customer; however, the use of these cables ensures that the emergency off wiring will be RF tight.

In [Illustration 7-4](#) black and red wires are used for connections on the ends of Runs 296 and 297. Actually any pair of wires on these runs could be used so long as both ends are consistent with one another. (Runs 296 and 297 are actually nine wire cables.)

4 System Interconnects

4.1 System Interconnects General Information

The MR system uses many prefabricated interconnects with large connectors which greatly simplifies system installation. Due to variability of site physical layouts the GE provided interconnects length may result in excess length which must be properly managed in the site to minimize adverse impacts on system performance. There are several catalogs available to allow for the maximum variability of physical site layouts which the provided interconnects can accommodate while minimizing the excess interconnects length.

Details of cable group lengths provided by specific system configuration catalogs are contained in [Cable Groups Length Provided](#). Individual interconnects dimensional details are provided in the following:

- [L1 Interconnects](#)
- [L2 Interconnects](#)
- [L1 / L2 Interconnects](#)
- [L3 Interconnects](#)
- [L4 Interconnects](#)
- [L5 Interconnects](#)

4.2 Cable Groups Length Provided

Table 7-2 lists the specific usable length provided for each interconnect Group to determine the fixed site cable catalog which will best meet the specific site layout requires.

Table 7-2: Signa HDe 1.5T Length Provided By Fixed Site Catalogs

Location	Group	Between Units		Usable Length ft (m)
		From	To	
L1	42	PP1	EO1	68 (20.7) allows EO1 takeup of 15 ft (4.57 m) Refer to Emergency Off Wiring for additional information.
	45	PP1	MG2/3	37 (11.3)
	48	MS4	MS1	72 (22)
	78	Cabinet Ground Stud	MS1	51.5 (15.75) minus takeup at RF Common Ground Stud
	87	PP1	MG6	37 (11.3)
	88	MG6	MG3	16(4.88) Flexible vinyl hose can be cut to length during installation.
L2	75	MS5	PP1	42 (12.8) See Note 3
	81	EO2	PP1	40 (12.2)
	95	MSM1	PP1	67 (20.42) allows 8 ft (2.44 m) takeup at MSM1 See Note 1
	201	WC1	T-Joint	This cable shall be supplied by WC1 vendor.
	202	T-Joint	WC2	13.1 (4) Flexible water tubing
	203	WC2	MR2	23 (7) Flexible water tubing
L1/L2	27	MR2	MG2/3	30 (9.2)
	71	MS5	MS1	38.5 (9.5)
	86	WC1	MG2	78.7 (24) Flexible water tubing routed through waveguides in PP1.
L3	69	MDP	MS5	27 (8.23) allows 3 ft (0.91 m) takeup at MDP
	89	PD1	WC1	25.9(7.9)
	94	MSM1	MS5	49 (14.94) allows 8 ft (2.44 m) takeup at MSM1; See Note 1
	96	MSM1	MR2	39 (12) allows 8 ft (2.44 m) takeup at MSM1; See Note 1
L4	79	OW1	PA1	5 (1.5) minus takeup at PA1
	80	PA1	MG2	72 (21.9.5) allows 5 ft (1.52 m) takeup at PA1 (See Note 5) Pneumatic tubing is continuously routed from PA1 through PP1 and MG3 to MG2
	92	PP1	OW1	72 (22)
L5	43	MR2	RF Door Switch	72 (22) allows 15 ft takeup at RF Door Switch
	90	PD1	OW	65 (20)
	91	MR2	OW1	68 (21)

Location	Group	Between Units		Usable Length ft (m)
		From	To	
Notes				
<ol style="list-style-type: none"> 1. 1.5T Magnet Catalog (M3335SE) provides Magnet Monitor interconnects and Shield/Cryo Cooler Compressor to Magnet interconnects included in this Group. 2. 1.5T Magnet Catalog (M3335SE) provides some Penetration Panel to Magnet Enclosure interconnects included in this Group. 3. Shield/Cryo Cooler Compressor Catalog (M20022FE or M20032FE/M29762SS) provides Shield/Cryo Cooler Compressor to Magnet interconnects in this Group. 4. If installation requires greater than listed for pneumatic tubing between the squeeze bulb, located on the front of the Magnet Enclosure, and the Patient Alert Control Box (PA1), located near the Operator Workspace, an Extender Kit (46-317758P2) must be ordered. The Extender Kit consists of a small Extender Box (to be mounted in Equipment Room) and 95 feet (29.0 meter) of pneumatic tubing. 				

4.3 L1 Interconnects

Illustration 7-5 shows the cable Groups which are included in Location 1 interconnects within the Magnet Room.

Illustration 7-5: System L1 Interconnects Diagram

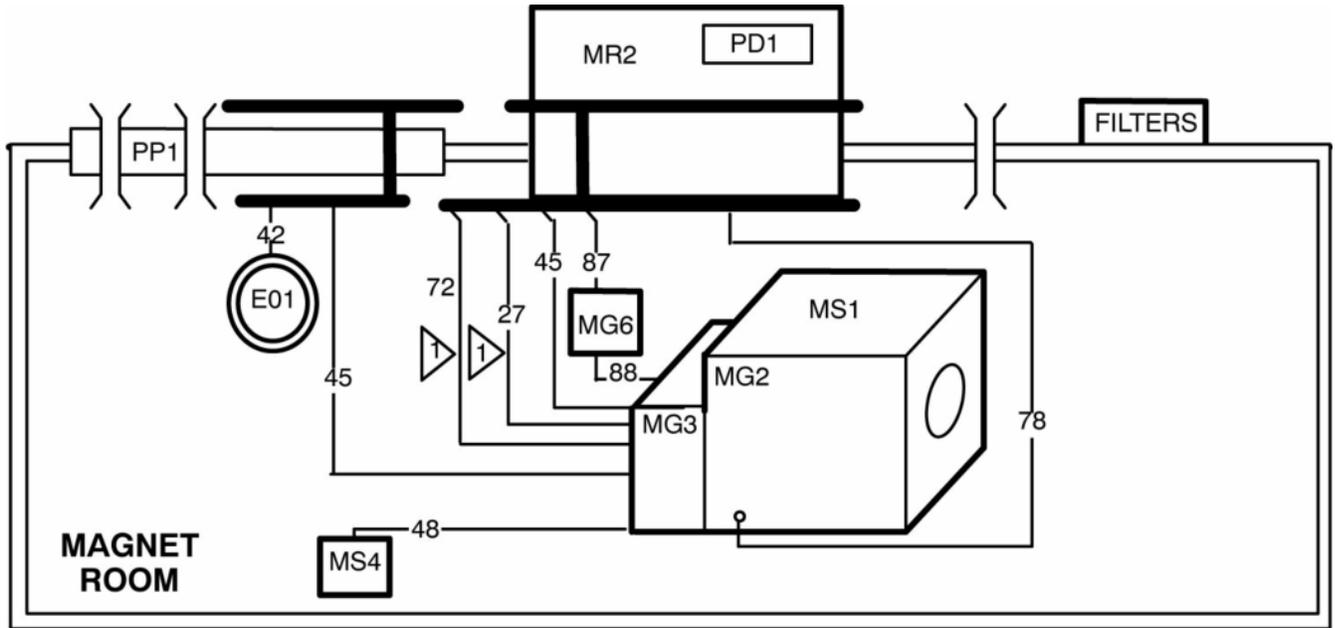


Table 7-3 contains details of the specific interconnects for each Group. Conduit or pipe is not recommended for cable runs since the system uses many prefabricated cables with large connectors. Unless otherwise specified, cables and components listed are supplied by GE.

Table 7-3: L1 Cable Groups Interconnects Details

Group	Group Area in. ² (mm ²)	Between Units		Run #	Cable Di- ameter in. (mm)	Plug Pulling Diameter x Length in. (mm)		Notes
		From	To			From	To	
42	0.096 (61.94)	PP1	EO1	297	0.35 (8.9)	1.30x2.00 (33.5x50.8)	Hard Wired	Emergency Off
45	4.473 (2839)	PP1	MG2/3	282	0.464 (11.8)	2.30x2.00 (57.2x50.8)	2.30x2.00 (57.2x50.8)	Audio
				624	0.26 (6.6)	Ring Terminals	1.00x1.38 (25.4x35.1)	Run provided by Shield/Cryo Cooler Compressor cata- log
				2011/ 2012	1.04 (26.4)	1.04x2.00 (26.4x50.8)	1.04x2.00 (26.4x50.8)	Run 711/712 is flexible conduit containing fiber op- tic cables with a minimum bend ra- dius of 2 in. (51 mm). Run provided by Magnet catalog

Group	Group Area in. ² (mm ²)	Between Units		Run #	Cable Di- ameter in. (mm)	Plug Pulling Diameter x Length in. (mm)		Notes
		From	To			From	To	
				2013	0.525 (13.3)	2.80x2.00 (70.4x50.8)	2.80x2.00 (70.4x50.8)	Run provided by Magnet catalog
				2014	0.34 (8.64)	1.60x2.00 (40.6x50.8)	1.60x2.00 (40.6x50.8)	Run provided by Magnet catalog
				2020	0.212 (5.38)	0.57x1.125 (14.5x28.6)	0.57x1.125 (14.5x28.6)	
				2018	0.212 (5.38)	0.57x1.125 (14.5x28.6)	0.57x1.125 (14.5x28.6)	
45 cont.				2019	0.212 (5.38)	0.57x1.125 (14.5x28.6)	0.57x1.125 (14.5x28.6)	
				2021	0.212 (5.38)	0.57x1.125 (14.5x28.6)	0.57x1.125 (14.5x28.6)	
				2022	0.212 (5.38)	0.57x1.125 (14.5x28.6)	0.57x1.125 (14.5x28.6)	
				828	0.31 (7.75)	2.30x2.00 (57.2x50.8)	2.30x2.00 (57.2x50.8)	Run provided by Magnet catalog
				829	0.30 (7.62)	1.30x2.00 (33.5x50.8)	1.30x2.00 (33.5x50.8)	Run provided by Magnet catalog
				2023	0.59 (15.0)	1.50x2.50 (38.1x63.5)	1.50x2.50 (38.1x63.5)	RF Transmit Cable Cut to length at site
				2024	0.71 (18.0)	2.75x2.25 (69.9x57.2)	2.75x2.25 (69.9x57.2)	RF Receive Cable
				2025	0.45 (11.4)	2.75x2.25 (69.9x57.2)	2.75x2.25 (69.9x57.2)	RF Receive Cable
				2030	0.525 (13.3)	2.80x2.00 (71.1x50.8)	2.80x2.00 (71.1x50.8)	
				2031	0.525 (13.3)	2.80x2.00 (71.1x50.8)	2.80x2.00 (71.1x50.8)	
48	0.071 (45.6)	MS4	MS1	606	0.30 (7.6)	0.65x1.85 (16.5x47.0)	0.65x1.85 (16.5x47.0)	Run provided by Magnet catalog
78	0.338 (218)	Cabinet Ground Stud	MS1 Ground Stud	2050	0.464 (11.79)	Hard Wired	Ring Terminal	1 ground wire
87	0.673 (228)	PP1	MG6	2001	0.195 (4.95)	Ring Terminal	Ring Terminal	The usable length is based on MG6 being mounted on floor and floor rout- ing of cables.
				2002	0.64 (16.3)	Ring Terminals	2.28x3.85 (57.9x97.8)	
				2002	0.64 (16.3)	Ring Terminals	2.28x3.85 (57.9x97.8)	
88	49.09 (29,952)	MG6	MG3	--	6.5 (165.1)	Flexible vinyl hose	Flexible vinyl hose	The flexible vinyl hose is cut to length during installation. Site Collector cata- log provides this in- terconnect.
				--	4.5 (104.3)	Flexible vinyl hose	Flexible vinyl hose	

4.4 L2 Interconnects

Illustration 7-6 shows the cable Groups which are included in Location 2 between Penetration Panel (PP1) and components in Equipment Room.

Table 7-4 contains information on interconnects between Penetration Panel (PP1) and components in Equipment Room (Location L2). Conduit or pipe is not recommended for cable runs since the system uses many prefabricated cables with large connectors. Unless otherwise specified, cables and components listed in are supplied by GE.

Illustration 7-6: System L2 Interconnects Diagram (Type A)

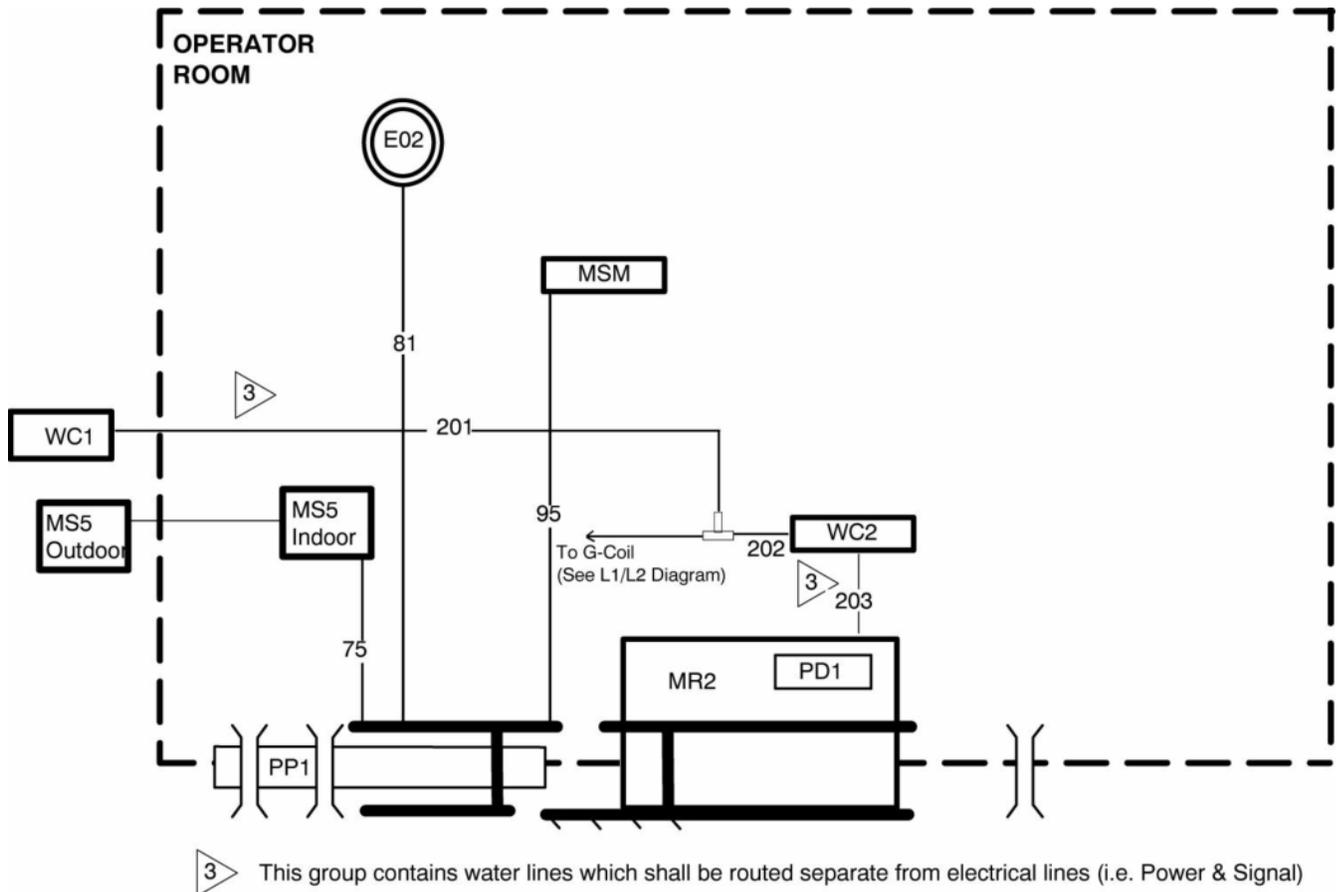


Illustration 7-7: System L2 Interconnects Diagram (Type B)

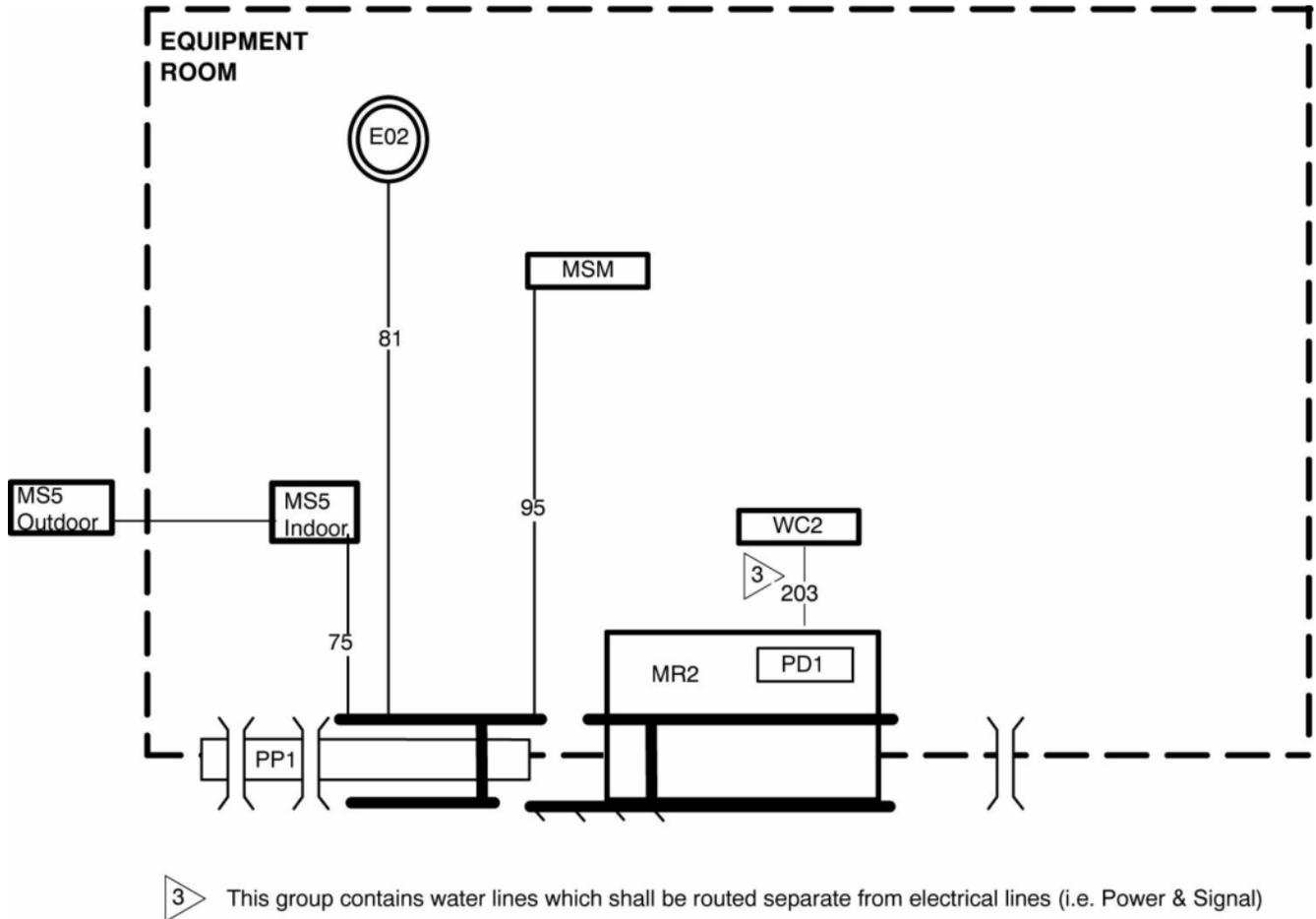


Table 7-4: L2 Cable Groups Interconnects Details

Group	Group Area in. ² (mm ²)	Between Units		Run #	Cable Di- ameter in. (mm)	Plug Pulling Diameter x Length in. (mm)		Notes
		From	To			From	To	
75	0.035 (22)	MS5	PP1	623	0.21 (5.28)	1.00x1.38 (25.4x35.1)	Ring Terminals	Run provided by Shield/Cryo Cooler Compressor cata- log Existing Run is reused.
81	0.460 (297.3)	EO2	PP1	296	0.35 (8.9)	Hard Wired	1.30x2.00 (33.5x50.8)	Refer to Emergen- cy Off Wiring
95	0.22 (144)	MSM1	PP1	824	0.44 (11.2)	2.30x2.00 (57.2x50.8)	2.30x2.00 (57.2x50.8)	
				825	0.30 (7.62)	1.30x2.00 (33.5x50.8)	1.30x2.00 (33.5x50.8)	
201	0.884(573)	WC1	T-Joint	2048/2049	0.75 (19)	Flexible Tubing	Flexible Tubing	See Note2
202	0.884(573)	T-Joint	WC2	2048/2049	0.5 (13)	Flexible Tubing	Flexible Tubing	See Note2
203	0.884(573)	WC2	MR2	2042/2043	0.5 (13)	Flexible Tubing	Flexible Tubing	See Note2

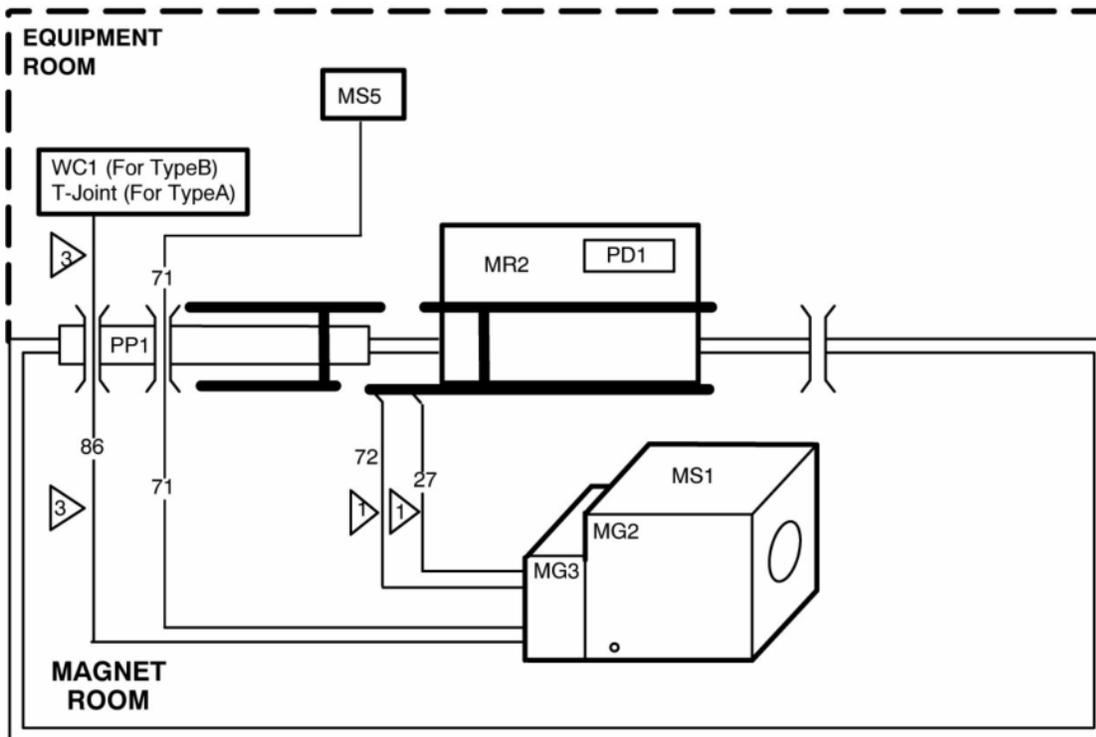
Group	Group Area in. ² (mm ²)	Between Units		Run #	Cable Di- ameter in. (mm)	Plug Pulling Diameter x Length in. (mm)		Notes
		From	To			From	To	
Note 1 The PDU is a module (PD1) in the lower portion of the System Cabinet (MR3). Note 2: This group contains water lines which shall be routed separate from electrical lines (i.e. power & signal)								

4.5 L1 / L2 Interconnects

Illustration 7-8 shows the cable Groups which are included in shared between Location 1 / Location 2 the Magnet Room and Equipment Room routing through the Penetration Panel (PP1).

Table 7-5 contains information on interconnects which the length is shared between the Magnet Room and Equipment Room (Location L1/L2) routing through the Penetration Panel (PP1). Conduit or pipe is not recommended for cable runs since the system uses many prefabricated cables with large connectors. Unless otherwise specified, cables and components listed are supplied by GE.

Illustration 7-8: System L1/L2 Interconnects Diagram



- 1 MUST BE CUT AND CONNECTED TO PP1 AT SITE.
NOTE: IMPEDANCE IS NOT CRITICAL SO EXCESS CABLE SHOULD BE CUT OFF.
- 3 THIS GROUP CONTAINS WATER LINES WHICH SHALL BE ROUTED SEPARATE FROM ELECTRICAL LINES (I.E. POWER & SIGNAL).

Table 7-5: L1/L2 Shared Cable Groups Interconnects Details

Group	Group Area in. ² (mm ²)	Between Units		Run #	Cable Di- ameter in. (mm)	Plug Pulling Diameter x Length in. (mm)		Notes
		From	To			From	To	
27	3.450 (740)	MR3	MG3	2015	1.21 (30.7)	Ring Terminals	Ring Terminals	Ruted through waveguide in PP1, cut to length at site.
				2016	1.21 (30.7)	Ring Terminals	Ring Terminals	
				2017	1.21 (30.7)	Ring Terminals	Ring Terminals	
71	4.28 (2758)	MS5	MS1	621 622	1.65 (41.9)	2.00x3.75 (50.8x95.3)	2.00x3.75 (50.8x95.3)	Run provided by Shield/Cryo Cooler

Group	Group Area in. ² (mm ²)	Between Units		Run #	Cable Di- ameter in. (mm)	Plug Pulling Diameter x Length in. (mm)		Notes
		From	To			From	To	
					1.65 (41.9)	2.00x3.75 (50.8x95.3)	2.00x3.75 (50.8x95.3)	Compressor cata- log
Note: Group 71 Runs 621 and 622 are continuous helium lines routed through PP1. Bend radius of Runs 621 and 622 is 8 in. (203.2 mm). Cable diameter includes foam insulation installed on lines.								
72	0.59 (15.0)	MR2	MG2/3	2005	0.59 (15.0)	1.5x2.50 (38.1x63.5)	1.5x2.50 (38.1x63.5)	
Note: These runs are RF Transmit Cables. Runs 1126/1128 and 1125/1127 must be cut to length and connected via PP1 at site. Usable length provided is for routing in Equipment Room and Magnet Room.								
86 See Note 1	0.884 (573)	W1	MG2	--	0.75 (19.1)	Flexible Tubing	Flexible Tubing	These Runs are routed through waveguides in PP1.
				--	0.75 (19.1)	Flexible Tubing	Flexible Tubing	
Note 1 This Group contains water lines which shall be routed separate from electrical lines (i.e. power & signal).								

4.6 L3 Interconnects

Illustration 7-9 shows the cable Groups which are included in Location 3 between components within Equipment Room.

Table 7-6 contains information on interconnects between components within Equipment Room (Location L3). Conduit or pipe is not recommended for cable runs since the system uses many prefabricated cables with large connectors. Unless otherwise specified, cables and components listed are supplied by GE.

Illustration 7-9: System L3 Interconnects Diagram

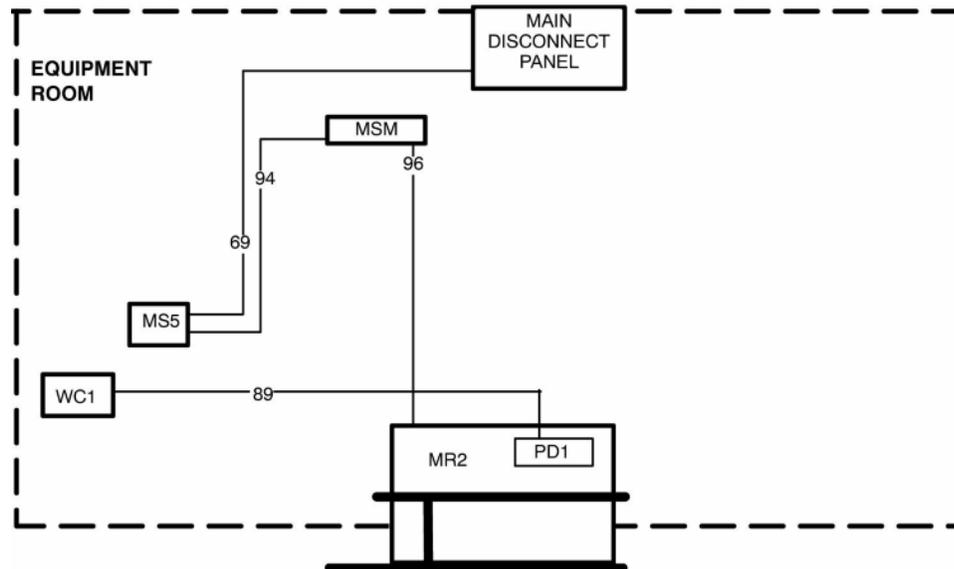


Table 7-6: L3 Cable Groups Interconnects Details

Group	Group Area in. ² (mm ²)	Between Units		Run #	Cable Diameter in. (mm)	Plug Pulling Diameter x Length in. (mm)		Notes
		From	To			From	To	
69	1.31 (842)	MDP	MS5	--	1.29 (32.75)	Hard Wired	Hard Wired	Both ends have liquid tight connector which wires pass through for hard wire connections.
89	0.635 (16.1)	PD1 See Note 1	WC1	2046	0.34 (8.64)	1.60x2.00 (40.6x50.8)	1.60x2.00 (40.6x50.8)	#10 AWG / 3 wire Power cable
94	0.09 (58.6)	MSM	MS5	826	0.34 (8.64)	1.60x2.00 (40.6x50.8)	1.60x2.00 (40.6x50.8)	Run provided by Magnet catalog
96	0.09 (58.6)	MSM	MR2	823	0.34 (8.64)	1.60x2.00 (40.6x50.8)	1.60x2.00 (40.6x50.8)	Run provided by Magnet catalog

Note 1 The PDU is a module (PD1) in the lower portion of the System Cabinet (MR2).

4.7 L4 Interconnects

Illustration 7-10 shows the cable Groups which are included in Location 3 between the Operator Workspace (OW) and Penetration Panel (PP1).

Table 7-7 contains information on interconnects between the Operator Workspace (OW) and PP1 (Location L4). Conduit or pipe is not recommended for cable runs since the system uses many prefabricated cables with large connectors. Unless otherwise specified, cables and components listed are supplied by GE.

Illustration 7-10: System L4 Interconnects Diagram (Type A)

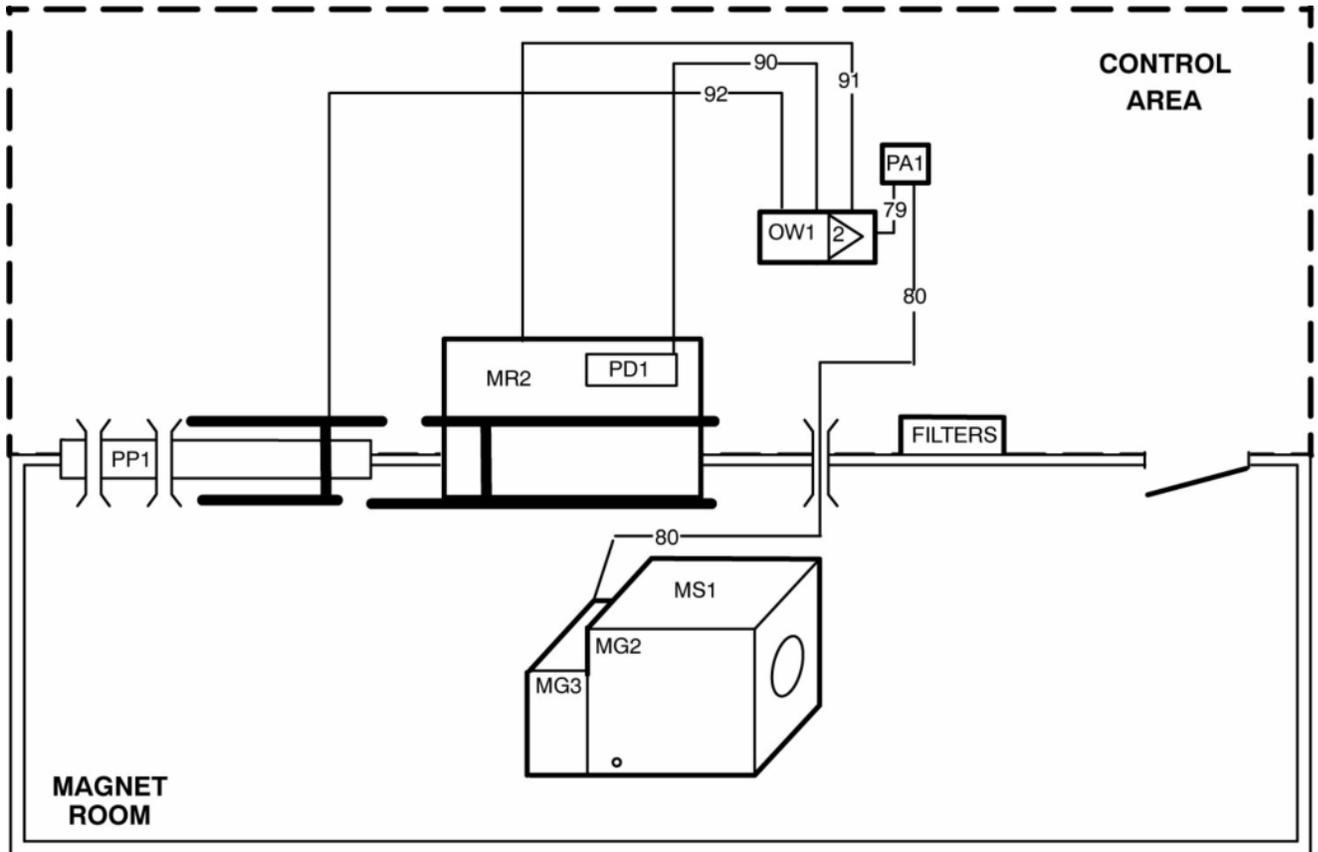


Illustration 7-11: System L4 Interconnects Diagram (Type B)

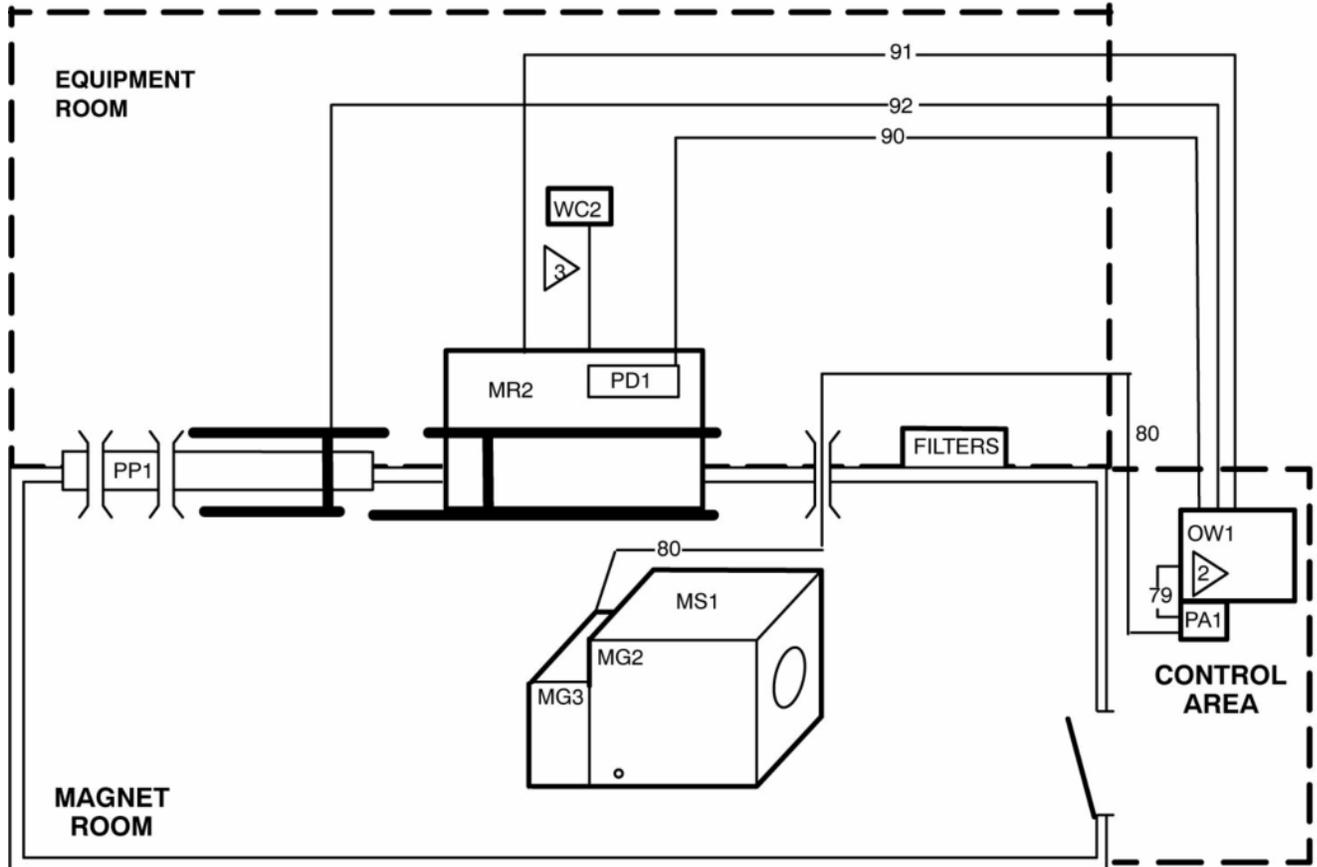


Table 7-7: L4 Cable Groups Interconnects Details

Group	Group Area in. ² mm ²)	Between Units		Run #	Cable Di- ameter in. (mm)	Plug Pulling Diameter x Length in. (mm)		Notes
		From	To			From	To	
79	0.02 (8)	OW1	PA1	--	0.13 (3.2)	3.00x3.00 (76.2x76.2)	0.38x1.75 (9.6x44.5)	
80 See Note 1	0.05 (32)	PA1	MG2	--	0.25 (6.4)	pneumatic tubing	pneumatic tubing	This pneumatic tubing is continuously routed from PA1 through PP1 and MG3 to MG2.
92	0.15 (99)	PA1	OW1	1085	0.44 (11.2)	2.30x2.00 (57.2x50.8)	2.30x2.00 (57.2x50.8)	

Note: 1 If installation requires greater than 97 feet (29.6 meters) of pneumatic tubing between the squeeze bulb, located on the front of the Magnet Enclosure, and the Patient Alert Control Box (PA1), located near the Operator's Console or Operator Workspace, an Extender Kit (46-317758P2) must be ordered. The Extender Kit consists of a small Extender Box (to be mounted in Equipment Room) and 95 feet (29.0 meter) of pneumatic tubing.

4.8 L5 Interconnects

Illustration 7-12 shows the cable Groups which are included in Location 3 between the Operator Workspace (OW) and components in Equipment Room.

Table 7-8 contains information on interconnects between the OW and components in Equipment Room (Location L5). Conduit or pipe is not recommended for cable runs since the system uses many prefabricated cables with large connectors. Unless otherwise specified, cables and components listed are supplied by GE.

Illustration 7-12: System L5 Interconnects Diagram (Type A)

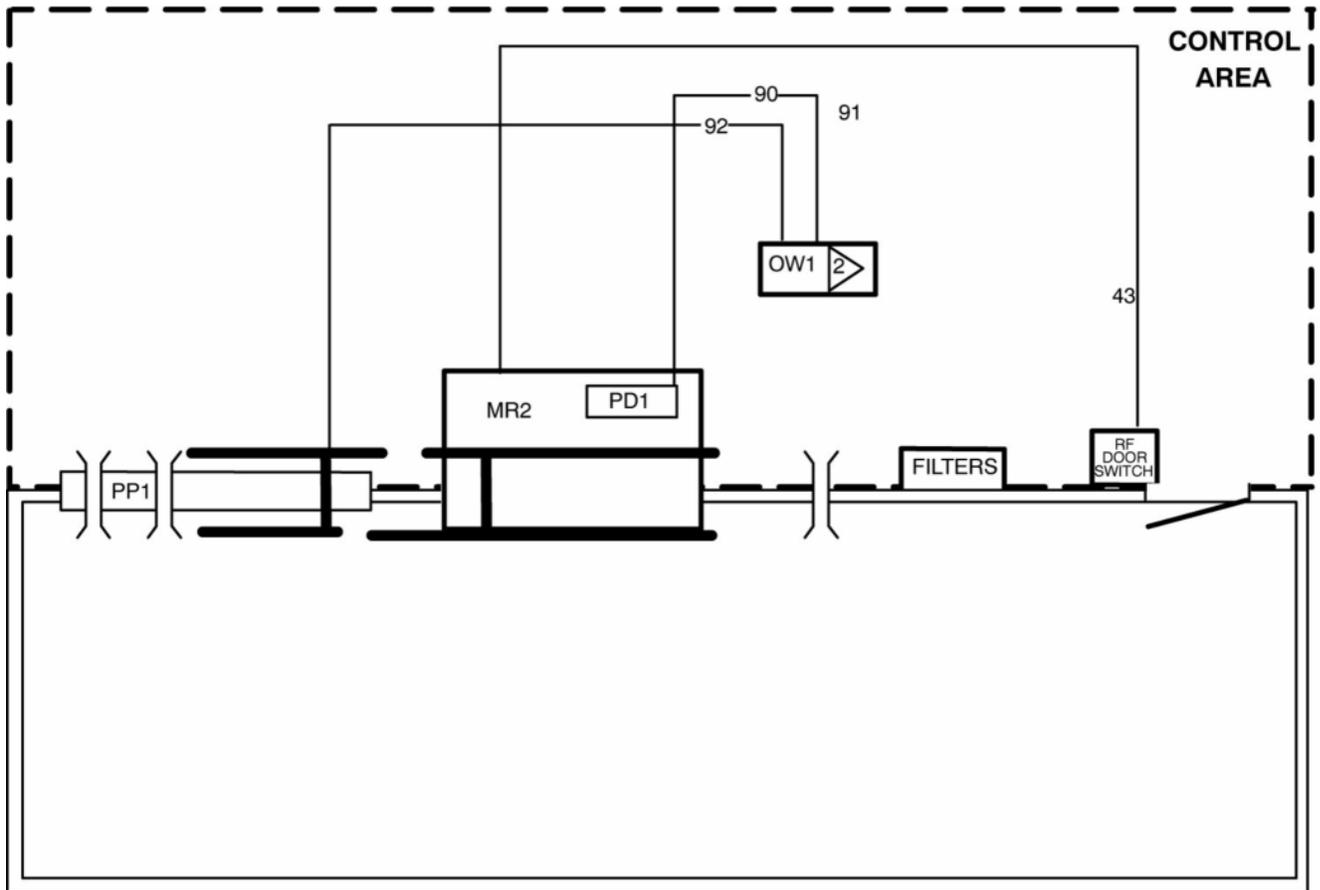


Illustration 7-13: System L5 Interconnects Diagram (Type B)

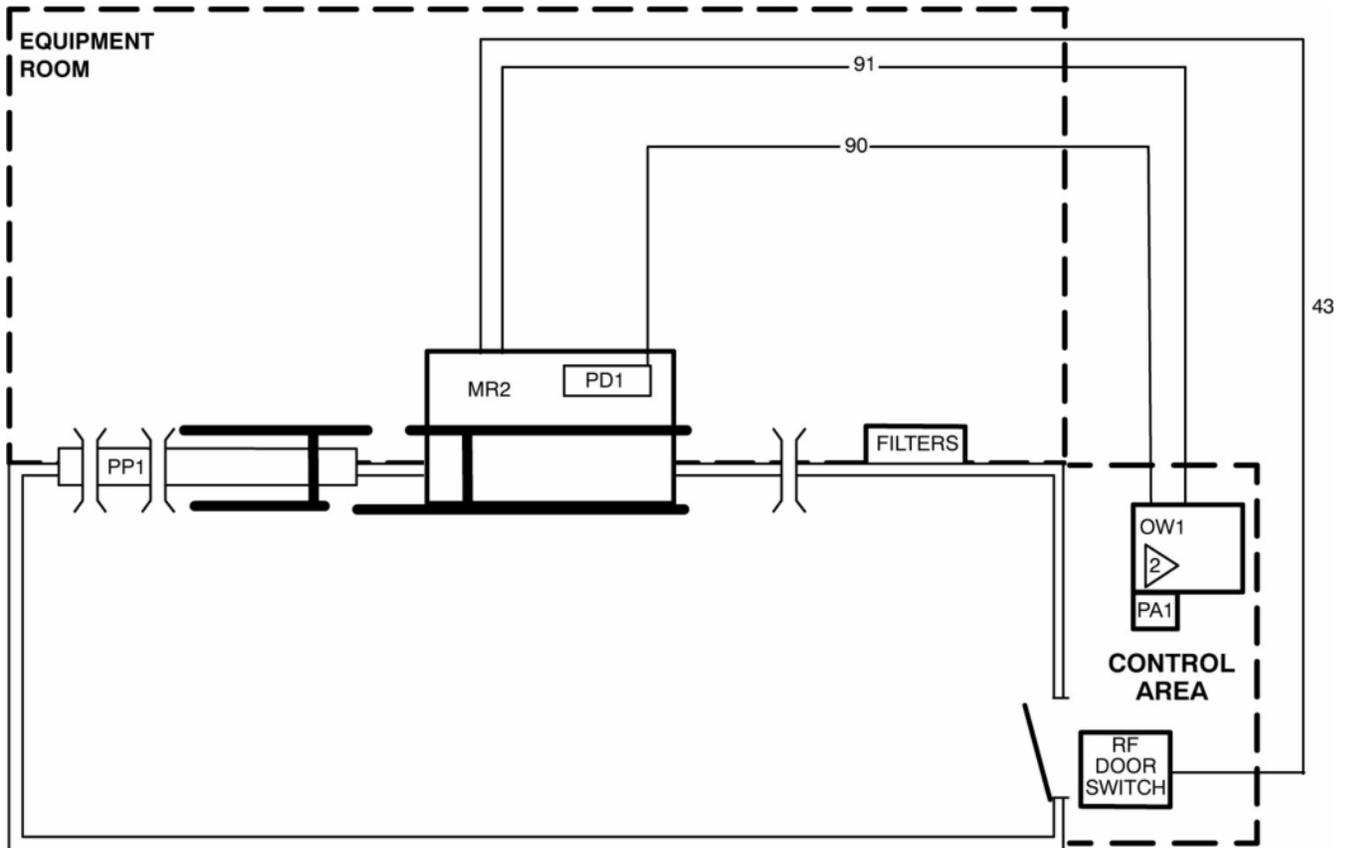


Table 7-8: L5 Cable Groups Interconnects Details

Group	Group Area in. ² mm ²)	Between Units		Run #	Cable Di- ameter in. (mm)	Plug Pulling Diameter x Length in. (mm)		Notes
		From	To			From	To	
43	0.10 (62)	MR2	RF Door Switch	2010	0.35 (8.9)	1.30x2.00 (33.5x50.8)	Hard Wired	RF Door Switch provided by RF Screen Room ven- dor. Usable length allows RF Door Switch takeup of 15 ft (4.57 m).
90	0.03 (18)	PD1 See Note 1	OW1	2033	0.70 (17.78)	Hard Wired	Hard Wired	#10 AWG / 4 wire power cable
91	0.14 (90)	MR2	OW1	2036	0.33 (8.30)	1.75x2.00 (44.5x50.8)	1.75x2.00 (44.5x50.8)	
				2034	0.31 (7.75)	1.30x2.00 (33.5x50.8)	1.30x2.00 (33.5x50.8)	

Note 1 The PDU is a module (PD1) in the lower portion of the System Cabinet (MR2).

4.9 Customer Supplied Interconnects

Illustration 7-14 shows the cable Groups which are customer supplied.

Table 7-9 contains the list of customer supplied interconnects for the MR system and references to location of detail information for the specific interconnects.

Illustration 7-14: System Customer Supplied Interconnects Diagram (Type A)

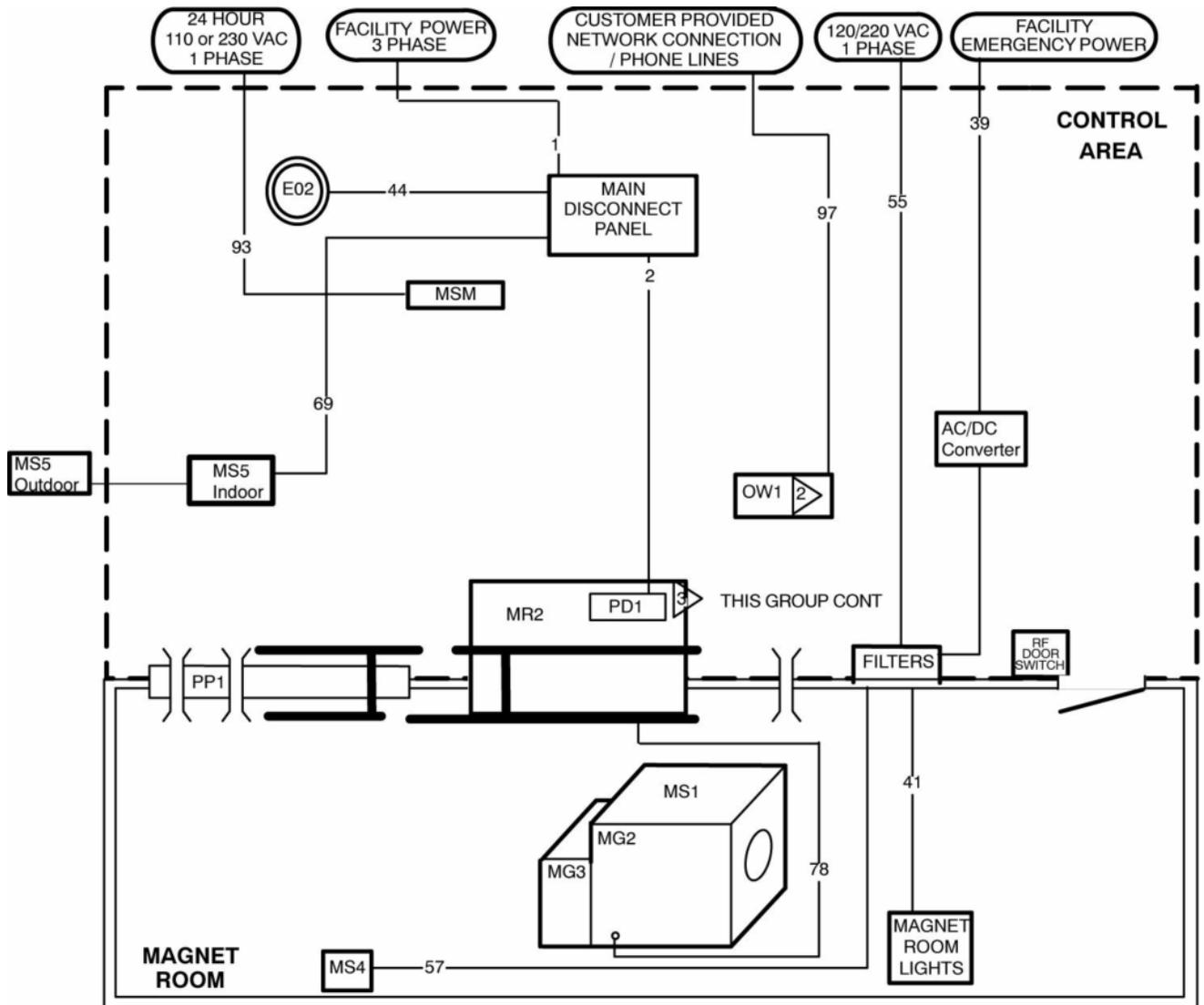
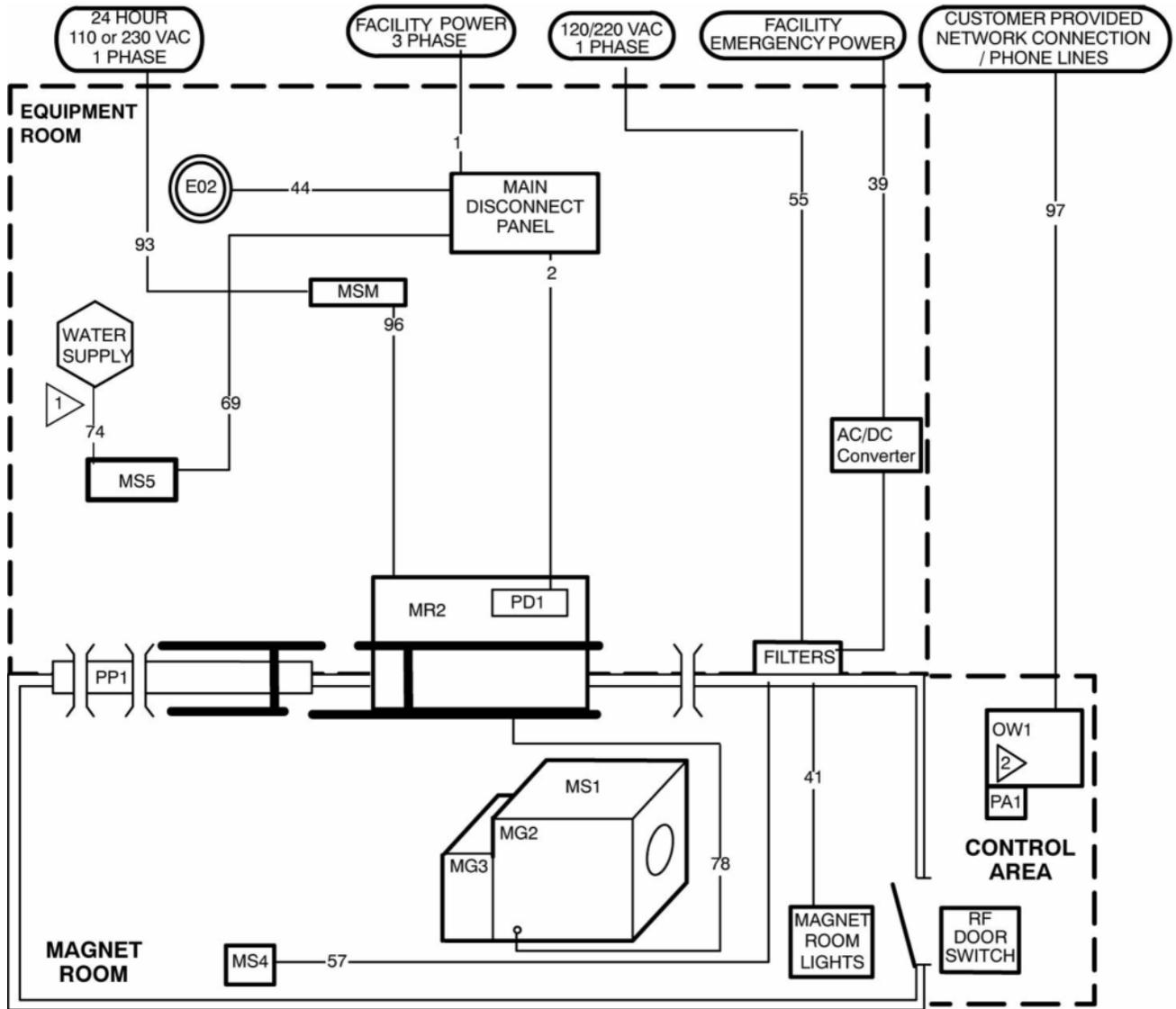


Illustration 7-15: System Customer Supplied Interconnects Diagram (Type B)



1 THIS GROUP CONTAINS WATER LINES WHICH SHALL BE ROUTED SEPARATE FROM ELECTRICAL LINS (I.E. POWER & SIGNAL)

Table 7-9: Customer Supplied Interconnects

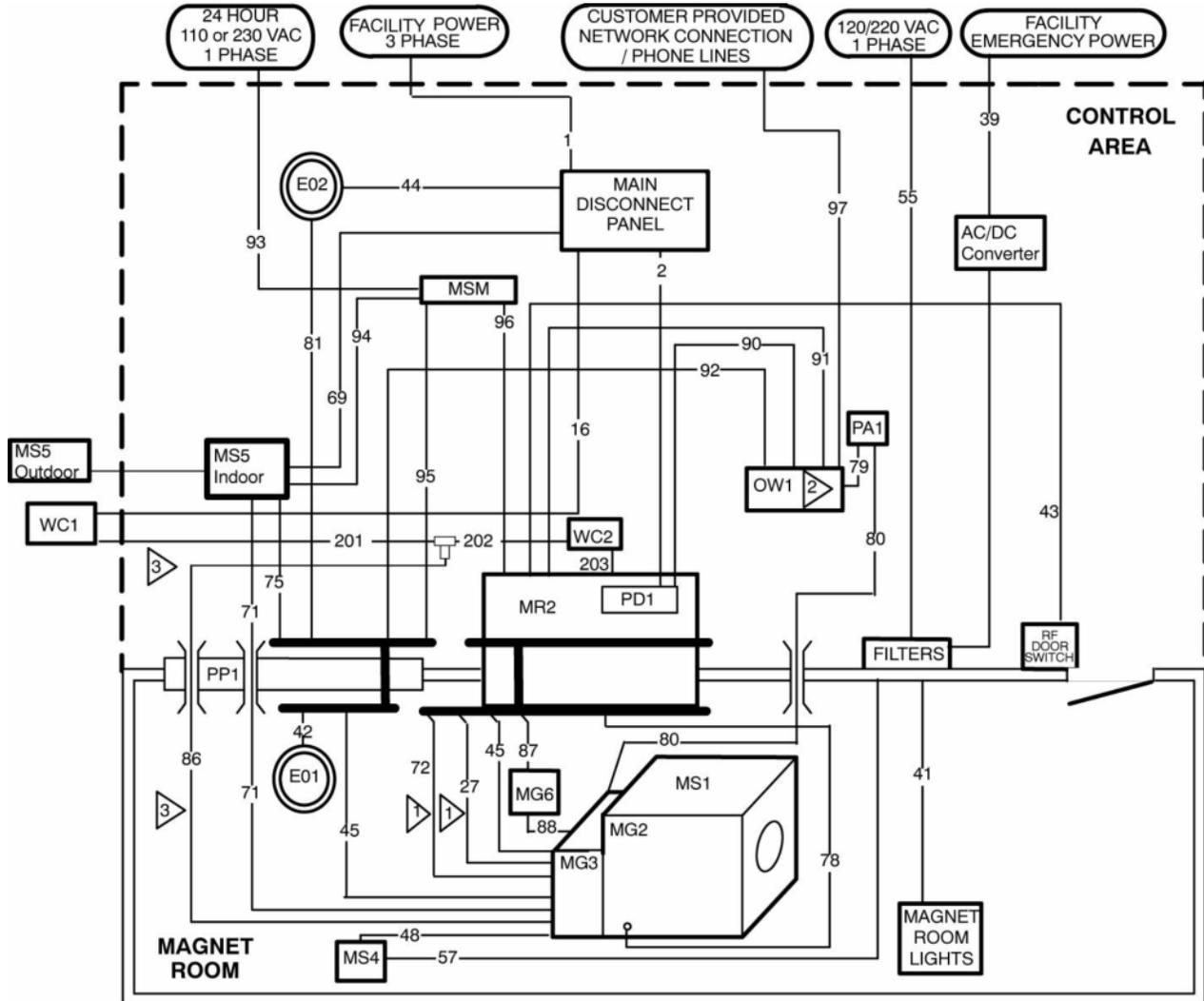
Group #	Between Units		Notes
	From	To	
1	Facility Power	MDP	See Note 1.
2	MDP	PD1 See Note 2	Refer to Chapter 6, System Power Distribution Unit for wire size information.
3	Facility Emerg Power Filter	PP1	Customer supplied Ground.
39	Facility Emergency Power	Filter	Refer to Chapter 6, DC Lighting Controller (Facility Option) for DC Lighting Controller cabling.

Group #	Between Units		Notes
	From	To	
41	Filter	Magnet Room Lights	Refer to Chapter 6, Emergency Power and Chapter 6, DC Lighting Controller (Facility Option) .
44	MDP	EO2	Refer to Emergency Off Wiring .
55	Facility Power	Filter	Customer supplied Magnet Room power (refer to Chapter 6, System Power Introduction and Chapter 8, Electrical).
57	Filter	MS4	Customer supplied (refer to Chapter 6, System Power Introduction).
74		MS5	
97	Network &/or Phone Line Connection	MSM1 or MSM4 (Option)	Refer to Chapter 3, System Monitoring and Support Connectivity for additional customer network and/or phone line information. WITH UPS FOR MAGNET MONITOR OPTION: Customer provided phone line routed through UPS for transient protection, refer to Group 26.
<p>Notes</p> <ol style="list-style-type: none"> 1. If low Voltage Step-Up Transformer Option (R4500AW or R4500BE) is used then customer supplied interconnects are required between facility power, transformer and MDP. 2. The PDU is a module (PD1) in the lower portion of the HFD/PDU Cabinet (MR1). 			

4.10 Cable Group and Location Cross Reference

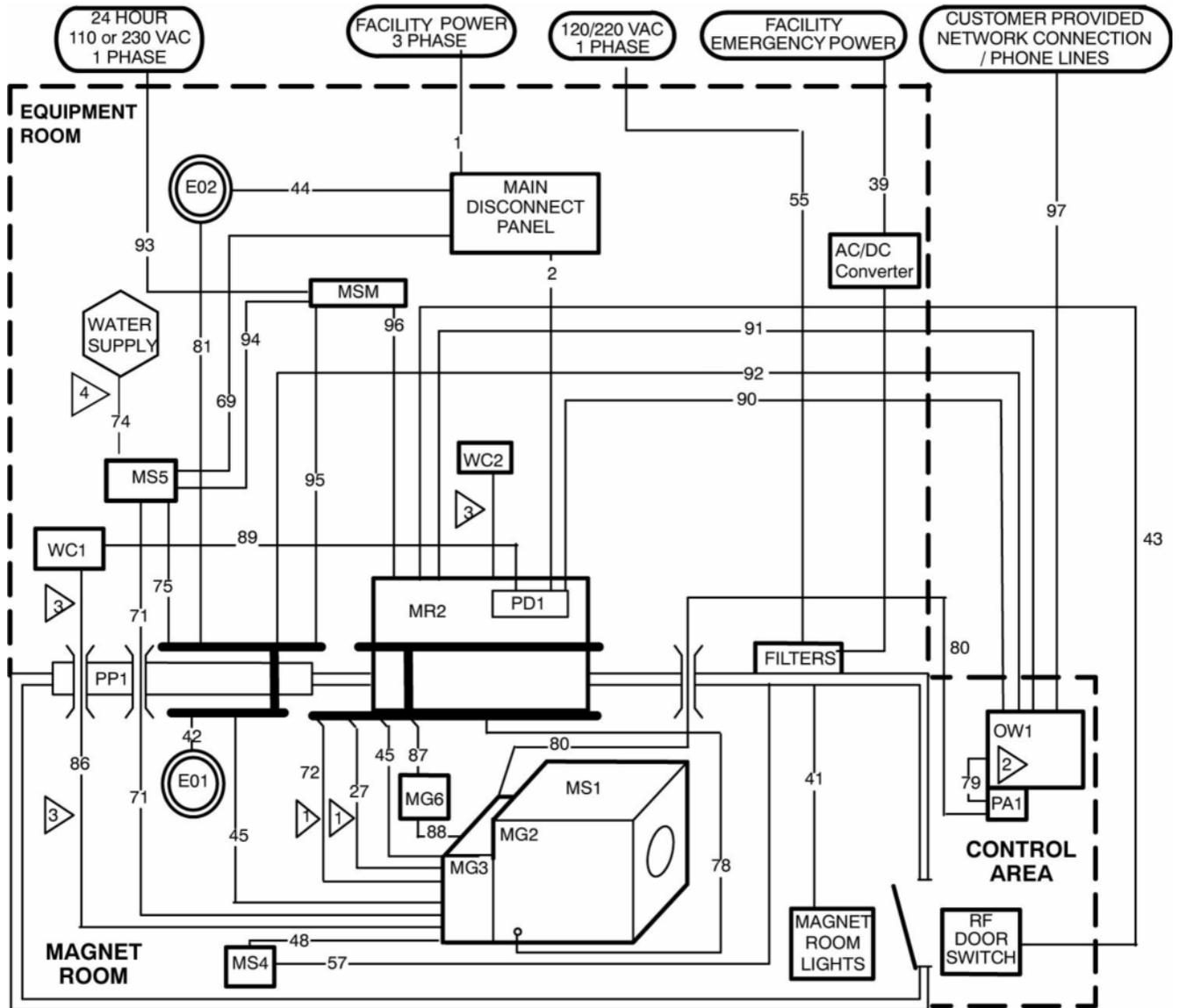
Cable groups shown in Illustration 7-16 are listed in Table 7-10 which contains the Location for each Group and a reference to the subsection or table which has the group content details and the usable length provided by the listed Site Collector catalogs.

Illustration 7-16: Signa HDe 1.5T System Group Interconnect Diagram (Outdoor Chiller Type)



- 1 MUST BE CUT AND CONNECTED TO PP1 AT SITE.
 NOTE: IMPEDANCE IS NOT CRITICAL SO EXCESS CABLE SHOULD BE CUT OFF.
- 2 OPERATOR WORKSPACE (OW1) SUBSYSTEM EQUIPMENT IS PROVIDED WITH MAXIMUM LENGTH CABLES POSSIBLE. SEVERAL OW ASSEMBLIES ARE MOUNTED TO OW TABLE & OW INTERCONNECTS ARE ROUTED THROUGH TABLE CABLE TRAY. FOR REFERENCE USE ONLY THE OW1 RUN NUMBERS FOR LINUX PC ARE 1059, 1060, 1061, 1062, 1063, 1064, 1065, 1066, 1067, 1068, 1069, 1070, 1071, 1074, 1075 AND FOR OCTANE COMPUTER ARE 049, 792, 793, 794, 795, 796, 797, 798, 799, 806, & 807.
- 3 THIS GROUP CONTAINS WATER LINES WHICH SHALL BE ROUTED SEPARATE FROM ELECTRICAL LINES (I.E POWER AND SIGNAL)

Illustration 7-17: Signa HDe 1.5T System Group Interconnect Diagram (Indoor Chiller Type)



- 1 MUST BE CUT AND CONNECTED TO PP1 AT SITE.
NOTE: IMPEDANCE IS NOT CRITICAL SO EXCESS CABLE SHOULD BE CUT OFF.
- 2 OPERATOR WORKSPACE (OW1) SUBSYSTEM EQUIPMENT IS PROVIDED WITH MAXIMUM LENGTH CABLES POSSIBLE. SEVERAL OW ASSEMBLIES ARE MOUNTED TO OW TABLE & OW INTERCONNECTS ARE ROUTED THROUGH TABLE CABLE TRAY. FOR REFERENCE USE ONLY THE OW1 RUN NUMBERS FOR LINUX PC ARE 1059, 1060, 1061, 1062, 1063, 1064, 1065, 1066, 1067, 1068, 1069, 1070, 1071, 1074, 1075 AND FOR OCTANE COMPUTER ARE 049, 792, 793, 794, 795, 796, 797, 798, 799, 806, & 807.
- 3 THIS GROUP CONTAINS WATER LINES WHICH SHALL BE ROUTED SEPARATE FROM ELECTRICAL LINES (I.E POWER AND SIGNAL)
- 4 For Water Cooled Compressor only.
THIS GROUP CONTAINS WATER LINES WHICH SHALL BE ROUTED SEPARATE FROM ELECTRICAL LINS (I.E. POWER & SIGNAL)

Table 7-10: Location & Cable Group Cross Reference To Run Details

Cable Group #	Between Units		Location See Note 1 for L numbers definition	Group Content Details Shown
	From	To		
1	Facility Power	MDP	Customer Supplied	Customer Supplied Interconnects

Cable Group #	Between Units		Location See Note 1 for L numbers definition	Group Content Details Shown
	From	To		
2	MDP	PD1	Customer Supplied	Customer Supplied Interconnects
3	Facility Emergency Power Filter	PP1	Customer Supplied	Customer Supplied Interconnects
4 to 14	--	--	Group Not Used	--
15 See Note 2	MS5	MRCC Unit #2	L3	Refer to appropriate configuration: Interconnects For MRCC Option Located Outdoors .
16	Facility Power	MRCC Unit	Customer Supplied	Refer to appropriate configuration: Interconnects For MRCC Option Located Outdoors
17 to 19	--	--	Group Not Used	--
20 to 26	--	--	Group Not Used	--
27	MR3	MG2	L1/L2	L1 / L2 Interconnects
28 to 38	--	--	Group Not Used	--
39	Facility Emergency Power	Filter	Customer Supplied	Refer to Chapter 6, DC Lighting Controller (Facility Option)
40	--	--	Group Not Used	--
41	Filter	Magnet Room Lights	Customer Supplied	Refer to Chapter 6, Emergency Power and Chapter 6, DC Lighting Controller (Facility Option)
42	PP1	EO1	L1	L1 Interconnects
43	MR2	RF Door Switch	L5	L5 Interconnects
44	MDP	EO2	Customer Supplied	Customer Supplied Interconnects
45	PP1/MR2	MG2/3	L1	L1 Interconnects
46 to 47	--	--	Group Not Used	--
48	MS4	MS1	L1	L1 Interconnects
49	--	--	Group Not Used	--
50	MRCC Unit located outdoor	See Section reference at right	Customer Supplied	Refer to Interconnects For MRCC Option Located Outdoors
51	--	--	Group Not Used	--
52	MRCC Unit	RCP	L3	Refer to Interconnects For MRCC Option Located Outdoors
53 to 54	--	--	Group Not Used	--
55	Facility Power	Filter	Customer Supplied	Customer Supplied Interconnects
56	--	--	Group Not Used	--
57	Filter	MS4	Customer Supplied	Customer Supplied Interconnects
58 to 68	--	--	Group Not Used	--
69	MDP	MS5	L3	L3 Interconnects
70	--	--	Group Not Used	--
71	MS5	MS1	L1/L2	L1 / L2 Interconnects
72	MR2	MG2/3	L1/L2	L1 / L2 Interconnects
73	--	--	Group Not Used	--
74 See Note 2	Facility Water Supply	MS5	Customer Supplied	For details refer to Chapter 5, Shield/Cryo Cooler Water Cooling For Site Provided Water Cooling

Cable Group #	Between Units		Location See Note 1 for L numbers definition	Group Content Details Shown
	From	To		
75	MS5	PP1	L2	L2 Interconnects
76	--	--	Group Not Used	--
78	Cabinet Ground Stud	MS1 Ground Stud	L1	L1 Interconnects
79	OW1	PA1	L4	L4 Interconnects
80	PA1	MG2	L4	L4 Interconnects
81	EO2	PP1	L2	L2 Interconnects
82 to 85	--	--	Group Not Used	--
86 See Note 2	WC2	MG2	L1/L2	L1 / L2 Interconnects
87	PP1	MG6	L1	L1 Interconnects
88	MG6	MG2/3	L1	L1 Interconnects
89	PD1	WC1	L3	L3 Interconnects
90	PD1	OW1	L5	L5 Interconnects
91	MR2	OW1	L5	L5 Interconnects
92	PP1	OW1	L4	L4 Interconnects
93	24 Hour Facility Power	MSM	Customer Supplied	Customer Supplied Interconnects
94	MSM	MS5	L3	L3 Interconnects
95	MSM	PP1	L2	L2 Interconnects
96	MSM	MR2	L3	L3 Interconnects
97	Network or Phone Line Connection	MSM1	Customer Supplied	Customer Supplied Interconnects
<p>Notes</p> <p>1. Interconnects LOCATION is defined as the following:</p> <ul style="list-style-type: none"> - L1 Within Magnet Room between components - L2 Between Penetration Panel (PP1) and components in Equipment Room - L1/L2 Between Magnet Room and Equipment Room components through PP1 - L3 Between components within Equipment Room - L4 Between Operator Workspace (OW) and PP1 - L5 Between OW and components in Equipment Room <p>2. This Group contains water lines which shall be routed separate from electrical lines (i.e. power & signal).</p>				

5 MRCC Additional Interconnects

5.1 Interconnects For MRCC Option Located Outdoors

NOTE: Refer to [Chapter 3, MRCC Siting Considerations](#) MRCC Equipment Installation Tasks Responsibility table for listing of responsibility for the specific installation tasks. Also refer to *AirSys Group User Manual: MEDICOOL 10.0 P6 R407C 10K Watt Gradient/Coldhead Compressor Water Chiller* for additional information and details.

The site design for the Outdoor installation of the MRCC unit must meet the following requirements for vertical separation and water lines/hose lengths limitations. **Installation of the MRCC outdoors must be in accordance with local and national codes.**

5.1.1 Vertical Separation Requirements

Maximum vertical separation from the Shield/Cryo Cooler Compressor is not to exceed 98 ft (30 m) with the MRCC above the MR system or 10 ft (3.1 m) with the MRCC below the MR system.

5.1.2 MRCC for Shield/Cryo Cooler Compressor: Water Cooling Lines & Hoses Requirements

Customer must provide water supply and return lines between the Outdoor MRCC and the AirSys supplied hoses for the Shield/Cryo Cooler Compressor.

- AirSys provides two 0.75 in. (19 mm) quick disconnect fittings at the MRCC for the Shield/Cryo Cooler Compressor water cooling lines connections, refer to [Chapter 3, MR Common Chiller \(MRCC\)](#) illustration for location of fittings on MRCC.
- AirSys provides 3.2 ft (1 m) section of 0.5 in. (12.7 mm) ID rubber hose with 0.5 in. to 0.75 in. (12.7 mm to 19.1 mm) hose adapter fitting to allow the 0.75 in. (19.1 mm) hose to be connected to the 0.5 in. (12.7 mm) fittings on the Shield/Cryo Cooler Compressor Cabinet.
- AirSys provides two 0.75 inch (19.1 mm) ID rubber hoses of 100 ft (30.5 m) total length to connect from Customer provided copper line hose barbs with ball valves to Shield/Cryo Cooler Compressor Cabinet. Site layout for the Shield/Cryo Cooler Compressor water cooling lines and hoses must meet the following:
 - Total line length from the MRCC located outdoor to the Shield/Cryo Cooler Compressor connection **MUST NOT EXCEED 200 ft (61 m)**. AirSys supplied rubber hoses for Shield/Cryo Cooler Compressor is a maximum length of 100 ft (30.5 m) total length.
 - If the 0.75 in. (19 mm) copper lines exceed 100 ft (30.5 m) then the rubber hose length must be reduced 1 ft (0.3 m) for every 1 ft (0.3 m) of copper line that exceeds 100 ft (30.5 m).
 - Outdoor installation copper lines must be thermally insulated.

5.1.3 RCP Data Cables Requirements

AirSys provides one data cable that connect between the RCP and the MRCC. This cable is 100 ft (30.5 m) total length. Usable length is dependent on MRCC and RCP placement [total length minus height of connection at MRCC located outdoor and height of connection at RCP, no cable takeup inside of MRCC or RCP].

NOTE: Contact AirSys to determine if additional length cable are possible based on specific site design.

5.1.4 Power Wiring Requirements

Power wiring between the MRCC and facility power is customer supplied. The MRCC maximum wire size is 6 AWG (16 mm²).

5.1.5 System Additional Interconnects

Illustration 7-18 shows the additional system Group Interconnect Diagram for the optional MRCC unit located outdoors. Each group contains one or more cables, refer to Table 7-11 and Table 7-12 for specifics.

Illustration 7-18: Optional MRCC Unit Located Outdoor & RCP Subsystem Group Interconnect Diagram

NOTE:

- ONLY INTERCONNECTS SPECIFIC TO MRCC SUBSYSTEM EQUIPMENT SHOWN HERE.

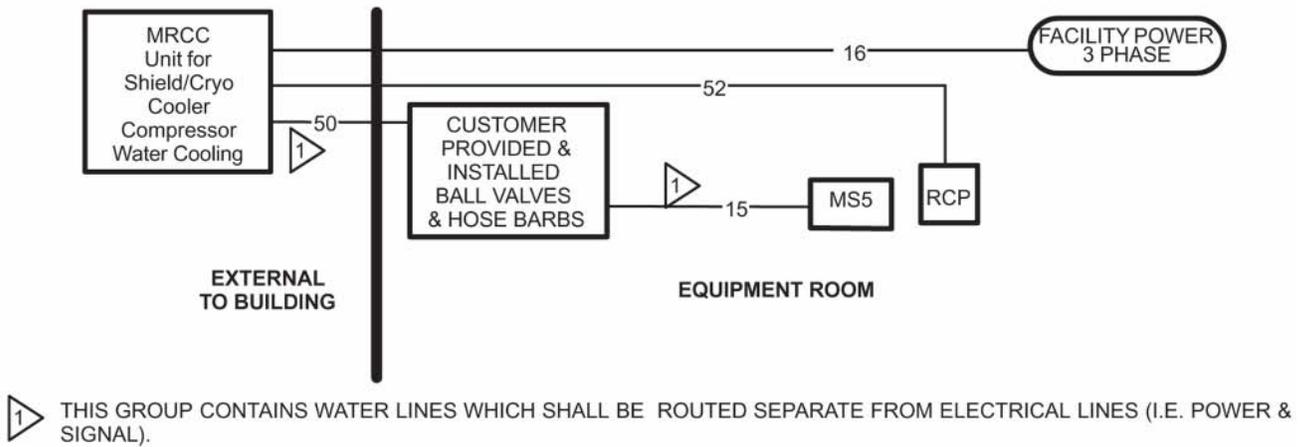


Table 7-11: 2 MRCC Units Outdoor & RCP Additional Interconnects - Customer Supplied

Group	Group Area in.² mm²)	Between Units		Usable Length	Run #	Cable Diameter in. (mm)	Plug Pulling Diameter X Length in. (mm)		Notes
		From	To				From	To	
16	--	Facility Power	MRCC	--	--	--	--	--	Power wiring Customer supplied.
50 See Note 1	--	MRCC outdoor	Customer ball valves & hose barbs for Shield/Cryo Cooler	See Note 3	--	--	copper supply line copper return line	copper supply line copper return line	See Note 4

Group P	Group Area in. ² mm ²)	Between Units		Usable Length	Run #	Cable Diameter in. (mm)	Plug Pulling Diameter X Length in. (mm)		Notes
		From	To				From	To	
Notes									
<ol style="list-style-type: none"> 1. This Group contains water lines which shall be routed separate from electrical lines (i.e. power & signal). 2. Customer to provide & install 0.75 (19 mm) ID copper lines for Gradient Coil water cooling supply & return with ball valve and hose barb terminations in the Equipment Room. 3. Groups 50 & 15 MUST NOT EXCEED Shield/Cryo Cooler Compressor water cooling lines and hoses limitations. 4. Customer to provide & install 0.75 (19 mm) ID copper lines for Shield/Cryo Cooler Compressor water cooling supply & return with ball valve and hose barb terminations in the Equipment Room. 									

Table 7-12: 2 MRCC Units Outdoor & RCP Additional Interconnects - L3

Group P	Group Area in. ² mm ²)	Between Units		Usable Length	Run #	Cable Diameter in. (mm)	Plug Pulling Diameter X Length in. (mm)		Notes
		From	To				From	To	
15 See Note 1	1.571 (1013)	customer provided hose barbs for Shield/ Cryo Cooler	MS5	55 (16.7) minus takeup at hose barbs See Note 2	--	1.0 (25.4)	flexible tubing	flexible tubing	
							flexible tubing	flexible tubing	
51	0.110 (71)	MRCC Unit #1 outdoor	RCP	92 (28.0) See Notes	--	0.375 (9.5)	hard wired	hard wired	Usable length allows the RCP to be mounted 5 ft (1.5 m) above the floor.
52	0.110 (71)	MRCC Unit #2 outdoor	RCP	92 (28.0) See Notes	--	0.375 (9.5)	hard wired	hard wired	Usable length allows the RCP to be mounted 5 ft (1.5 m) above the floor.
Notes									
<ol style="list-style-type: none"> 1. This Group contains water lines which shall be routed separate from electrical lines (i.e. power & signal). 2. Groups 50 & 15 MUST NOT EXCEED Shield/Cryo Cooler Compressor water cooling lines and hoses limitations specified. 									

6 Contractor Furnished Components

Table 7-13 lists contractor furnished components and details for connections to the system.

Table 7-13: Contractor Furnished Components

Associated Equipment	Material/Labor Provided By Customer Contractor
Main Disconnect Panel & System Emergency Off Buttons	Provide and install Main Disconnect Panel which meets the requirements of Chapter 6, Main Disconnect Panel (MDP) Requirements .
Power In Magnet Room	Provide and install power and wall duct for magnet rundown unit. (For power specifications see Chapter 6, System Power Introduction .)
System Ground	Provide ground cable between RF shielded room common ground point and Power Distribution Unit (PD1). (For cable specifications see Chapter 6, Grounding .)
Equipment Power <ul style="list-style-type: none"> • Main Disconnect Panel (MDP) • Magnet Rundown Unit • MDP to Power Distribution Unit (PDU) • MDP to MR Common Chiller (MRCC) • Service Outlet in Magnet Room • * Oxygen Monitor 	Provide and install power, duct work, receptacle, and coverplate for each item listed. (For power specifications refer to Chapter 6, System Power Introduction , Chapter 6, Critical Power Requirements , Chapter 6, Main Disconnect Panel (MDP)).
Plumbing	Provide and install all water cooling equipment, for customer supplied components & requirements refer to <ul style="list-style-type: none"> • Chapter 5, Shield/Cryo Cooler Temporary Backup Water Cooling • Chapter 5, Shield/Cryo Cooler Water Cooling For Site Provided Water Cooling
Cryogenic Venting	Provide and install cryogenic vent system, refer to: <ul style="list-style-type: none"> • Cryogenic Venting Introduction, Requirements For Outside Magnet Room, and Requirements for Inside Magnet Room • Chapter 8, Cryogenic Vent, Chapter 8, Determining Cryogenic Vent Location, Chapter 8, Waveguide, and Chapter 8, Guide for Outside RF Room Isolation Joint
Room Ventilation	Provide and install all room ventilation equipment (e.g. Magnet Room exhaust fan) for room ventilation specifications listed in Chapter 5, Room Ventilation .
Penetration Panel Mounting Hardware	RF Shielded Room vendor to provide appropriate mounting hardware for GE supplied Penetration Panel. (See Chapter 8, RF Penetration Panel .)
RF Door Switch And Cabling	RF shielded room vendor to provide and install RF door switches on all RF shielded room doors. All switches must be wired in series. GE supplies a 100 ft (30.5 m) cable from System Cabinet which is terminated with 2 leads. These leads are connected to the set of switches. Switches must be in the open position when RF door is open but closed when door is closed. (See Chapter 8, RF Door Switch .)
Notes * Optional Equipment ** The Pneumatic Patient Alert Control Box can be powered from an outlet on the Operator Workspace.	

7 Oxygen Monitor Option Interconnects

The Oxygen Monitor option consists of the following items:

- Oxygen Monitor
- Remote Oxygen Sensor Module
- Interconnect cables

Illustration 7-19 shows the Interconnect Diagram. Table 7-14 contains the cable data.

Illustration 7-19: Oxygen Monitor Option Cabling

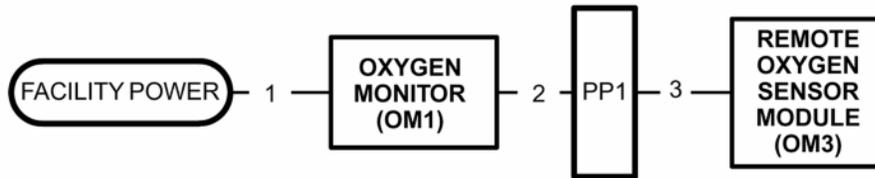


Table 7-14: Oxygen Monitor Interconnect List

Group	Group Area in. ² mm ²)	Between Units		Usable Length	Run #	Cable Di- ameter in. (mm)	Plug Pulling Diameter x Length in. (mm)		Notes
		From	To				From	To	
1	--	Facility Power	OM1	--	--	--	--	--	Customer sup- plied, recom- mend- ed power source for OM1 (refer to Chap- ter 6, Sys- tem Power Intro- duc- tion).
2	0.096 (61.94)	OM1	PP1	94 (28.7) minus takeup at OM1	457	0.35 (8.9)	Hard Wired	1.30x2.00 (33.5x50.8)	
3	0.096 (61.94)	PP1	OM3	84 (25.6) minus takeup at OM3	458	0.35 (8.9)	1.30x2.00 (33.5x50.8)	Hard Wired	

Chapter 8 RF Shielded Room

1 RF Shield Room Requirement

Improvements in MR imaging technology have increased imaging capabilities. MR procedures require a stable RF environment to achieve high resolution image quality. RF sources both inside and outside the Magnet Room have the potential to adversely affect image quality. Therefore the Magnet Room must be properly RF shielded to prevent external RF sources from entering the room. In addition, the selection of materials and construction methods of the RF Shield must be designed and installed to minimize the generation of adverse signals within the RF Shield and Magnet Room.

1.1 RF Shielding Background

RF sources which can adversely affect image quality may be generated by discrete frequency or broadband noise (RF) sources.

1.1.1 Discrete Frequency

Discrete RF interferences are narrowband and are fixed frequency in nature. The Magnet Room must be RF shielded from RF sources so external RF energy does not degrade the MR system RF receivers at the system imaging frequencies, refer to [Chapter 5, Ambient Radio Frequency Interference \(RFI\)](#). Some potential sources for discrete frequency signals are radio station transmitters, mobile or hand-held RF transmitting devices, etc.

1.1.2 Broadband RF Noise

Broadband RF noise is a single transient or continuous series of transient disturbances caused by an electrical discharge, for system imaging frequencies refer to [Chapter 5, Ambient Radio Frequency Interference \(RFI\)](#). Low humidity environmental conditions will have higher probability of electrical discharge, refer to [Chapter 5, Temperature and Humidity Specifications](#). The electrical discharge can occur due to electrical arcing (micro arcing) or merely a static discharge. Some potential sources capable of producing electrical discharge include:

- loose hardware/fasteners vibration or movement (electrical continuity must always be maintained)
- flooring material including raised access flooring (panels & support hardware) and carpeting
- electrical fixtures
 - lighting fixtures
 - track lighting
 - emergency lighting
 - battery chargers
 - outlets
- ducting for HVAC and cable routing
- RF Shield seals (walls, doors, windows, etc.).

1.2 RF Shielded Room Requirements

The Magnet Room RF Shield must meet the requirements defined in [Table 8-1](#) for the system to produce high quality MR images.

NOTE: The RF Attenuation and Ground Isolation are intended to control discrete RF signals and RF interference sources. The remaining parameters contained in [Table 8-1](#) are intended to minimize potential broadband noise sources.

Table 8-1: RF Shielded Room Requirements

Parameter (See Note *)	Requirements (See Note *)
RF Attenuation	100dB (100MHz ± 10MHz) planewave, refer to Chapter 12, RF Shielded Enclosure Test Guideline Frequency Range subsection.
Ground	<ol style="list-style-type: none"> 1. Ground Isolation: 1,000 ohms or greater 2. Primary Ground: All RF Shield components (walls, floor, ceiling, etc) must be electrically bonded together to form one common ground plane which is connected to the Facility Grounding Conductor. The RF Shield must be grounded back to the facility ground via the RF Common Ground Stud connection to the MR system PDU. NOTE: Introduction of facility power into the RF Shielded Room must not compromise the RF Shield Primary Ground. 3. Secondary Ground (Other grounds that connect the outside of the RF Shield Room to earth grounds are called secondary grounds): Secondary grounds must not compromise Ground Isolation of 1,000 ohms or greater. 4. Refer to Electrical Isolation for additional information on electrical isolation requirement.
Materials	<ol style="list-style-type: none"> 1. The choice of RF Shield material including fasteners is the responsibility of the customer's architect and RF vendor. 2. The choice of material must not affect magnet homogeneity (i.e. copper, brass or treated aluminum are non-magnetic and will not affect Magnet homogeneity). NOTE: Any steel RF Shield will affect the magnet's homogeneity and must be reviewed by GE Healthcare MR Siting and Shielding Group. 3. The floor under the Magnet in a 10 ft x 10 ft (3.048 m x 3.048 m) area must not be fabricated from magnetic materials, per Magnet Room Floors Magnetic Properties in Chapter 5, Construction Materials. 4. The Magnet Room floor materials must meet the requirements in Magnet Room Floors. 5. The door or any other moving or non-rigid parts must not be fabricated from magnetic materials. 6. The RF Shield integrity (attenuation) must not be compromised by corrosion for the anticipated duration of usage for MR imaging. The following items are critical: <ol style="list-style-type: none"> a. Avoid direct contact of materials of different solution potential (e.g. dissimilar metals galvanic corrosion) when selecting fastens to secure the RF screen material to the RF supporting structure. b. Ensure the RF shield seams/joints have overlaps that are properly dressed selecting proper material to avoid galvanic corrosion. c. Introduce sacrificial anodes to prevent corrosion of critical RF shield components. NOTE: Typically the RF Shield surrounds the Magnet Room finished walls, ceiling, and floor. Therefore the RF Shield may not be in a temperature and humidity controlled environment. d. RF Screen Room including all openings (i.e. windows, doors, vents, etc.) need acoustic properties to meet local regulations and customer requirements. NOTE: RF Screen Room doors with <55 db acoustic attenuation have caused customer acoustics issues.

Parameter (See Note *)	Requirements (See Note *)
Construction	<ol style="list-style-type: none"> 1. The design of the shield support system is the responsibility of the customer's architect and RF vendor. 2. RF Shield construction methods must not compromise RF Shield integrity (attenuation) for the anticipated duration of usage for MR imaging. <ol style="list-style-type: none"> a. When RF shield seams/joints are sealed with solder: all solder drips, cold solder joints, and cracked solder joints must be cleaned and repaired. b. RF Shield movement can cause micro electrical arcs (static discharge or broadband RF noise) that will cause MR image artifact known as White Pixel. c. Physical fluctuation of the RF Shield material can result in RF leaks due to seam openings, cracks, enlarged holes at fasteners. Physical fluctuation of the RF Shield can be generated by cyclic air pressure changes and door closures/openings. d. All electrical and mechanical connections and fasteners including screws, nails, nuts, bolts, clips clamps, concrete anchors, seismic anchors, etc. must be tightened and secured to supplier specifications so as not to become a potential broadband noise source. e. All fasteners must be solid locking devices such as t-nuts, PEM nuts or welded nuts; no self tapping screws allowed. f. The Magnet Room floor design and construction must meet the requirements in Floors. g. It is the customer's responsibility to coordinate mounting methods for equipment in the Magnet Room with the RF Shielded Room vendor to prevent RF leaks and secondary grounding problems. For additional information refer to Anchor Hardware For MR Equipment Inside RF Shield, Physical Characteristics, Anchor Location And Installation, Clamping Force (Tension) and Pull Test, RF Shield Integrity, Electrical Isolation, and Magnet Room Equipment Mounting. It is the customer's responsibility to coordinate mounting methods for equipment in the Magnet Room with the RF Shielded Room vendor to prevent RF leaks and secondary grounding problems. <div style="display: flex; align-items: center; margin-top: 10px;">  <div style="border: 1px solid black; background-color: yellow; padding: 5px; display: inline-block;">  <b style="font-size: 1.2em; margin-left: 5px;">CAUTION </div> </div> <p style="margin-top: 5px;">For safety reasons, magnetic materials must be secured to ensure magnetic components do not become projectiles.</p> <p style="margin-top: 5px;">Methods of securing must not loosen due to repeated use, some options include (but not limited to) redundant restrains straps or anchors/bolts with locking nuts.</p>
Testing	<ol style="list-style-type: none"> 1. The customer's architect and RF vendor are responsible for conducting testing to verify compliance with the requirements for RF attenuation and ground isolation. 2. The RF shielded room verification test is to be performed in the presence of a GE representative. 3. The FINAL RF Shielded room acceptance test shall be performed in accordance with Chapter 12, RF Shielded Enclosure Test Guideline.
Maintenance	<ol style="list-style-type: none"> 1. The customer is responsible for maintaining the RF Shield service life integrity for the anticipated duration of usage for MR imaging per the RF vendor's recommended maintenance. 2. The customer is responsible to notify the GE Service Representative of any RF shielded Room maintenance issues since there may be system performance impacts.
<p>NOTE: * The RF Shielded Room design, materials, construction, and installation shall be such to meet the requirements for the anticipated duration of usage for MR imaging.</p>	

2 Vents

2.1 Cryogenic Vent

Due to normal boil-off of liquid helium and the possibility of a quench with superconducting magnets, outside cryogenic venting is required. RF shielded room contractor is to provide one straight pipe with maximum 0.125 in. (3.175 mm) wall thickness for the cryogenic vent pipe/waveguide. The vent pipe/waveguide is to be made of non-magnetic material which is grounded to the RF room and electrically isolated from any other grounds. The vent pipe/waveguide must extend inside and outside of the RF shielded room, as per [Determining Cryogenic Vent Location](#) to allow for non-metallic isolation joint connections. The HVAC (heating, ventilation, and air conditioning) contractor is to make cryogenic vent connections to vent pipe/waveguide outside of the RF shield and GE will make the normal connection in the Magnet Room. Refer to Requirements for Inside Magnet Room for exceptions.

2.2 Cryogenic Vent Location

The cryogenic vent location on the magnet is shown below. The waveguide in the RF Shield must be within 0.25 in. (6.25 mm) of the center point of the vent.

Illustration 8-1: 1.5T Cryogen Vent Location

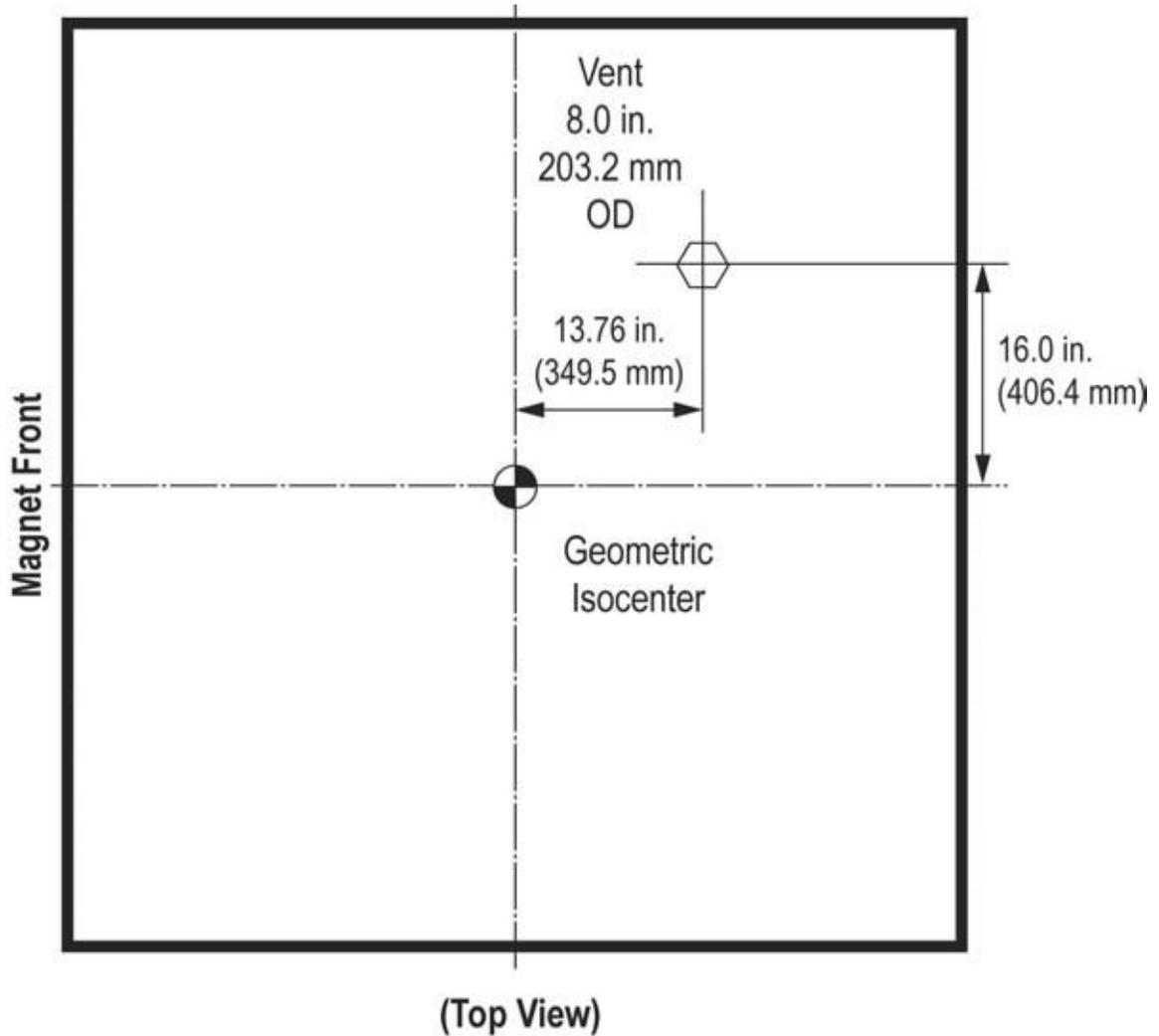
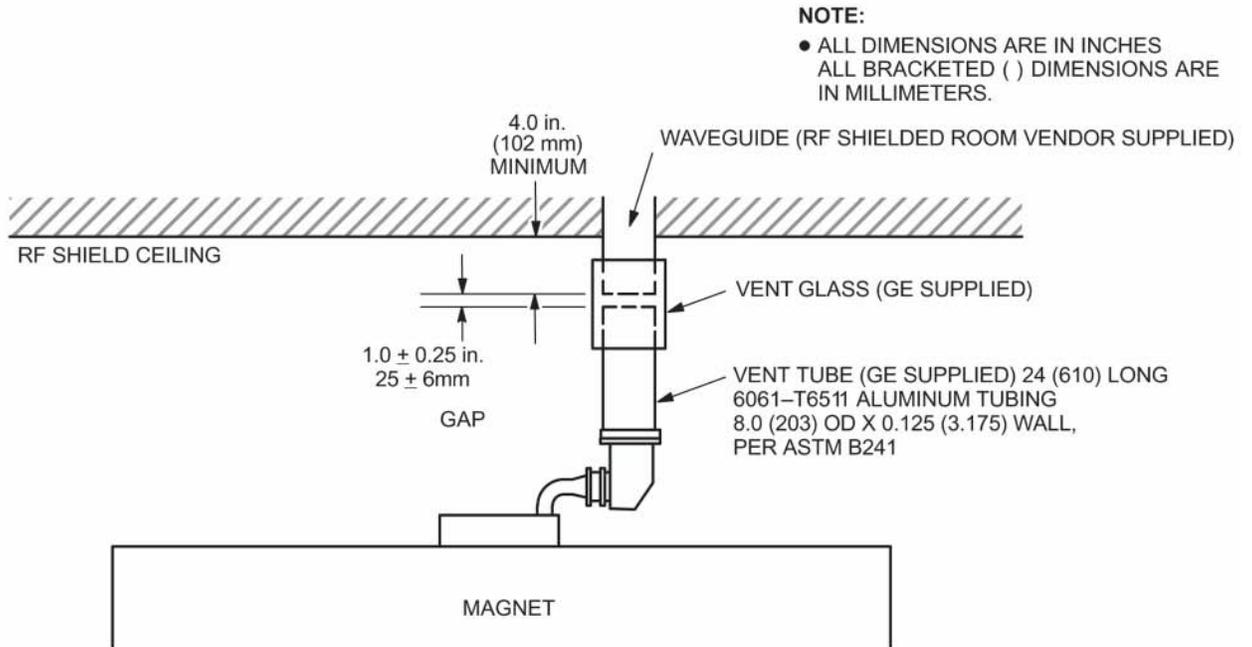


Illustration 8-2: Cryogenic Vent Routing



Refer to Cryogenic Venting , [Chapter 5, Requirements For Outside Magnet Room](#), and [Chapter 5, Requirements for Inside Magnet Room](#) for vent requirements.

2.3 Waveguide

RF shield room contractor/designer is responsible for choosing and installing a RF shield waveguide for the cryogen vent and customer specific cables/MR compatible system interconnects. Refer to [Table 8-2](#) for list of GE requirements for the waveguide.

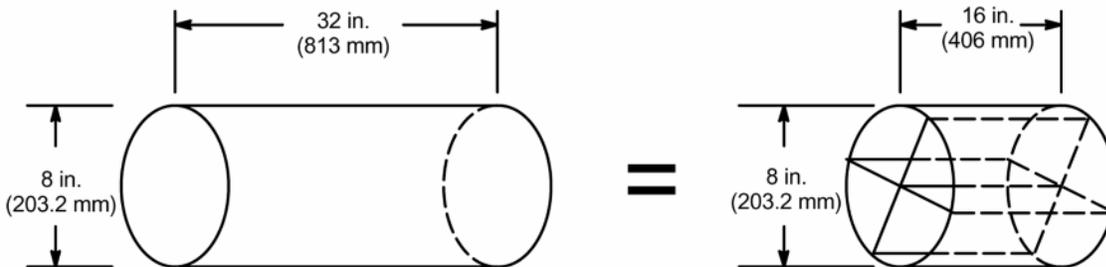
Table 8-2: Waveguide Requirements

Parameter	Requirements
Waveguide Size	The generally accepted length of the waveguide is four times the inside diameter of the tube (e.g., to match the 8 in. diameter GE Healthcare supplied cryogen vent adaptor, the waveguide must be a minimum of 32 in. long)
Waveguide Material	<ul style="list-style-type: none"> The Waveguide must be constructed from one of the GE accepted non-magnetic materials (i.e., stainless steel, aluminium, or copper). The waveguide must be made from the same material as the RF shielded enclosure to avoid dissimilar metal interfaces (i.e., galvanic reaction)
Waveguide Construction	<ul style="list-style-type: none"> The customer must work with the RF shield vendor to install any non-GE Healthcare penetration points The waveguide does not have to be positioned equally on either side of the RF shield Waveguides do not have to be completely straight (e.g., 90 degree elbows may be part of the waveguide). Shorter waveguide can be fabricated by dividing the inside volume into no more than four chambers (e.g., an 8 in. (203.2 mm) OD waveguide can be divided into four equal chambers, as shown in , the length of the waveguide may be decreased from 32 in. (813 mm) to 16 in. (406 mm). (Refer to <i>Site Environment chapter sections: Cryogenic Venting, Requirements For Outside Magnet Room, Requirements for Inside Magnet Room.</i>) 1 psig must be added to the pressure drop calculation to account for the pressure drop of the four chambered waveguide for cryogen vents Flat, honeycomb type waveguide is not acceptable.

Illustration 8-3: 4 Chamber Waveguide

NOTE:

- 1 psig MUST BE ADDED TO THE PRESSURE DROP CALCULATION TO ACCOUNT FOR THE PRESSURE DROP OF THE FOUR CHAMBERED WAVEGUIDE.
- IN A CASE OF WAVEGUIDE LENGTH RESTRICTION, A HALF LENGTH WAVEGUIDE WITH FOUR CHAMBERS MAY BE USED.



2.4 Guide for Outside RF Room Isolation Joint

The RF shielded room contractor/designer is responsible for choosing and installing an isolation joint outside of the RF shielded room as shown in Requirements For Outside Magnet Room. This isolation joint is required to maintain the single point ground concept for the RF shielded room.

Table 8-3 contains suggestions for the RF room isolation joint.

NOTE: GE supplies Ventglass and clamps which can be used for 8 in. (203 mm) diameter pipe ONLY. These materials may be used for isolation joint outside RF room at the contractor's option if the material meets the contractor's design requirements.

Table 8-3: Outside RF Room Isolation Joint Suggestions

Parameter	Isolation Joint Suggestions
Isolation Joint Material	<ul style="list-style-type: none"> • PVC, rubber or soil pipes must not be used to construct the isolation joint. • Ventglass and Lorenz clamp is a GE recommended method of achieving the isolation.
Isolation Joint Construction	<ul style="list-style-type: none"> • Ventglass: If the connection diameter is 8 in. (203.2 mm), a Ventglass connection method as shown in is recommended. • Lorenz clamp: If the connection diameter is 8 in. (203.2 mm), a Lorenz clamp connection as shown in is recommended. • The mating diameters must match within ± 0.125 in. (3 mm). • The Ventglass must not be used for structural support.
Suppliers	<p>Ventglass information may be obtained from:</p> <p>Industrial Machine & Fabricating Inc. 2808 E. Sammy's Lane Florence, SC 29506-3841 USA (843) 667-4582 indmachfab@aol.com</p> <p>Vent Fabric Inc. 5520 N. Lynch Avenue Chicago, IL 60630-1418 USA (800) 621-1207 or (773) 775-4477 www.ventfabrics.com</p> <p>Lorenz clamp information may be obtained from:</p> <p>Lorenz and Son Mfg. Co. LTD. P.O. Box 1002 Cobourg, Ontario, Canada K9A4W4 (905) 372-2240, fax (905) 372-4456</p>

2.5 HVAC

RF shielded room contractor is to install HVAC waveguides (open pipes or honeycomb-type) which penetrate room and to ensure waveguides are non-magnetic and electrically isolated. HVAC contractor is to determine size and number of vents, consistent with local codes.

Honeycomb-type waveguides must be accessible for annual customer inspection and cleaning / maintenance.

An exhaust fan placed outside the RF shielding with appropriate wave guide filtering is required for quick removal of helium gas in the event large amounts of helium disperse into the Magnet Room. The exhaust fan can be connected to the output relay of the optional oxygen monitor. The fan will then be activated in the event the room oxygen level is less than 18%. Refer to [Chapter 5, Room Ventilation](#) for other exhaust fan requirements.

3 Plumbing

All metallic pipes entering the RF Room, excluding cryogenic vent and floor drains, must be located within 30 inches (762 mm) of the RF common ground.



NOTICE

Mounting and support of all metallic pipes must comply with requirements in [RF Shielded Room Requirements](#) to minimize the possibilities of electrical discharge which can cause RF broadband noise.

NOTE: When welding in an MR room with system equipment installed, the return path for the welding must be in very close proximity to the welding. The close proximity is needed to make sure the welding currents do not cause damage to the system. Never use the building structure as a return path for welding.

3.1 Water

All pipe waveguides must comply with requirements in [RF Shielded Room Requirements](#) to minimize the possibilities of electrical discharge which can cause RF broadband noise. All plumbing must be in accordance with local and national codes.

3.2 Medical Gases

The customer should consider if medical gases are to be piped into the Magnet Room along with suction service for patient life support. Remember, all non-electrical entries into the Magnet Room must use appropriate waveguide. Special precaution must be taken to ensure that ferromagnetic medical gas cylinders are not brought into the Magnet Room.

3.3 Sprinklers

If using sprinklers in the Magnet Room, dry pipe systems have the advantage of reducing ground problems. However, all decisions regarding fire protection systems are the customer's responsibility. If wet-type sprinkler system is used, pipe penetration should be limited to one location.

4 Electrical

4.1 Facility Filter Ground Line

Ground Line of Filter for Facility Electrical Devices (Exam Room Lights, etc) must be connected to the equal level to the RF Shield.

4.2 Room Lighting



NOTICE

Installation and selection of lighting fixtures must comply with requirements in [RF Shielded Room Specifications](#) to minimize the possibilities of electrical discharge which can cause RF broadband noise.

Fluorescent lighting is not allowed in the Magnet Room due to the RF noise generated by the fluorescent light tubes. Dimmer switches must not be used; however, a selectable switch may be used to change the light intensity.

For additional Magnet Room lighting information refer to [Chapter 5, Lighting](#), [Chapter 6, Grounding](#), [Chapter 6, Emergency Power](#), [Chapter 6, DC Lighting Controller \(Facility Option\)](#).

Also refer to [Chapter 7, Customer Supplied Interconnects](#).

5 RF Shield Consideration for System Cabinet and Penetration Panel

This section describes method for mounting the GE MR System Cabinet and Penetration Panel. The penetration panel and System Cabinet must be covered on both sides for safety. If GE supplied adjustable covers are not used, customer must furnish covers or enclosures with key or tool required for opening to limit access to the panel.

Refer to following section for dimensions of System Cabinet and Penetration Panel.

- [Chapter 3, System Cabinet](#)
- [Chapter 3, Mesh Shield and System Cabinet Cover](#)
- [Chapter 3, Penetration Panel](#)

Regarding Special Consideration of System Cabinet, refer to [Chapter 3, System Cabinet Special Consideration](#).



NOTICE

Penetration Panel electrical and mechanical connections, mounting hardware, and installation must comply with requirements in [RF Shielded Room Requirements](#) to minimize the possibilities of electrical discharge can cause RF broadband noise.



NOTICE

The Penetration Panel mounting hardware must not loosen over time to maintain RF attenuation requirement in [RF Shielded Room Requirements](#) for the anticipated duration of usage for MR imaging. Some of the design parameter that can contribute to loosen of the Penetration Panel mounting hardware are: wall material compression over time, insufficient fasteners quantity or spacing, over or under tightness of mounting fasteners, insufficient locking mechanism (i.e. Locktight, double/locking nuts), etc.

The RF shielded room acceptance test must be performed after the opening is cut in the RF shielding for the GE Penetration Panel and Mesh Shield Tunnel. This acceptance test must be conducted with vendor supplied blank panel and the same mounting hardware to be used with the GE Penetration Panel and Mesh Shield Tunnel. It is the facility's responsibility to ensure that the RF Shielded Room Vendor testing meets the attenuation specifications listed in [RF Shield Room Requirement](#).

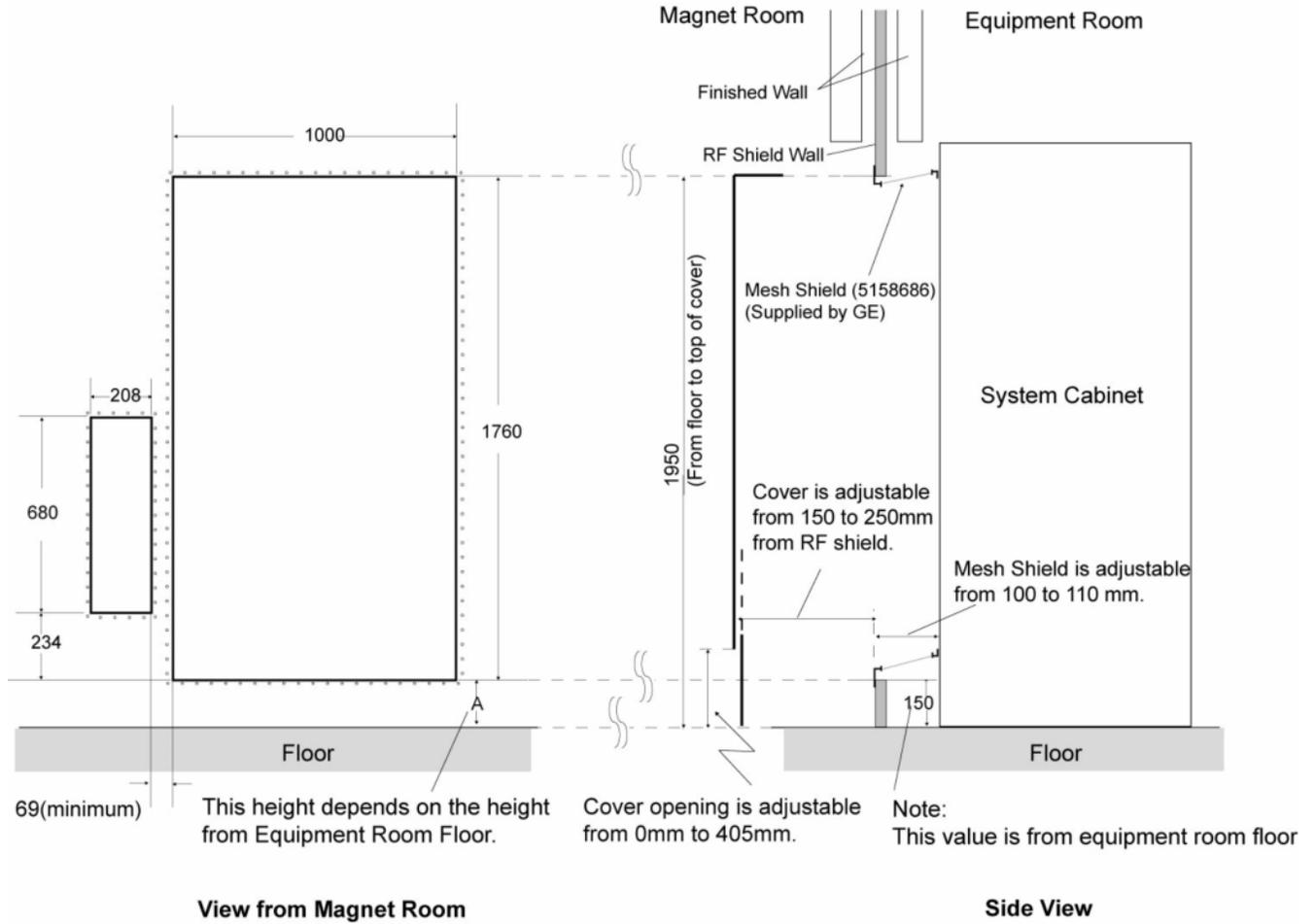
The Penetration Panel and System Cabinet must be covered on both sides for safety. If GE supplied adjustable covers are not used, customer must furnish covers or enclosures with key or tool required for opening to limit access to the panel. The mounting and clearance dimensions for the Penetration Panel and the System Cabinet are shown in this section.

Special Consideration for System Cabinet, refer to [Chapter 3](#),

[Illustration 8-4](#) shows the wall opening for System Cabinet and Penetration Panel.

Illustration 8-4: RF Shield Opening

System Cabinet and Penetration Panel Opening specification Note: All Dimensions are in millimeters



Notice 1:

If the Penetration Panel is placed at the opposite side of system cabinet, keep **169mm** or more between System Cabinet Opening and Penetration Panel Opening.

Notice 2:

Penetration Panel and System Cabinet must be placed on the same wall plane and they must not be placed further than 7m. If the condition above cannot be satisfied, it is necessary to consider the ground line and cooling water hose routing.

Notice 3:

System Cabinet Cover (Magnet Room Side) is supplied by GE.

Illustration 8-5 shows the equipment room side view of the wall opening. The dotted line shows the out line of the System Cabinet. make sure that the wall cutoff is not symmetric with System Cabinet center.

Illustration 8-5: Notice about System Cabinet Cut Off

Note that the system cabinet is placed as following illustration. (View from Equipment Room)
Right edge of the system cabinet is aligned to the right edge of the opening.

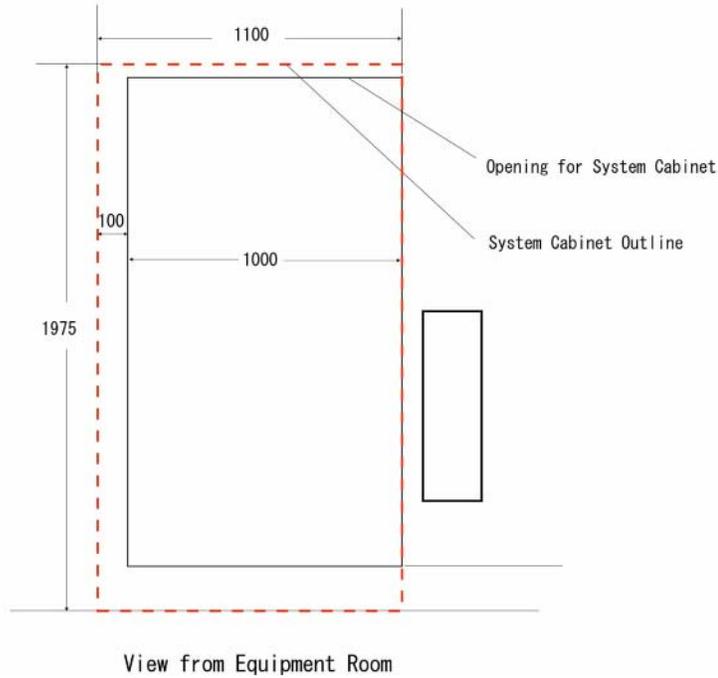
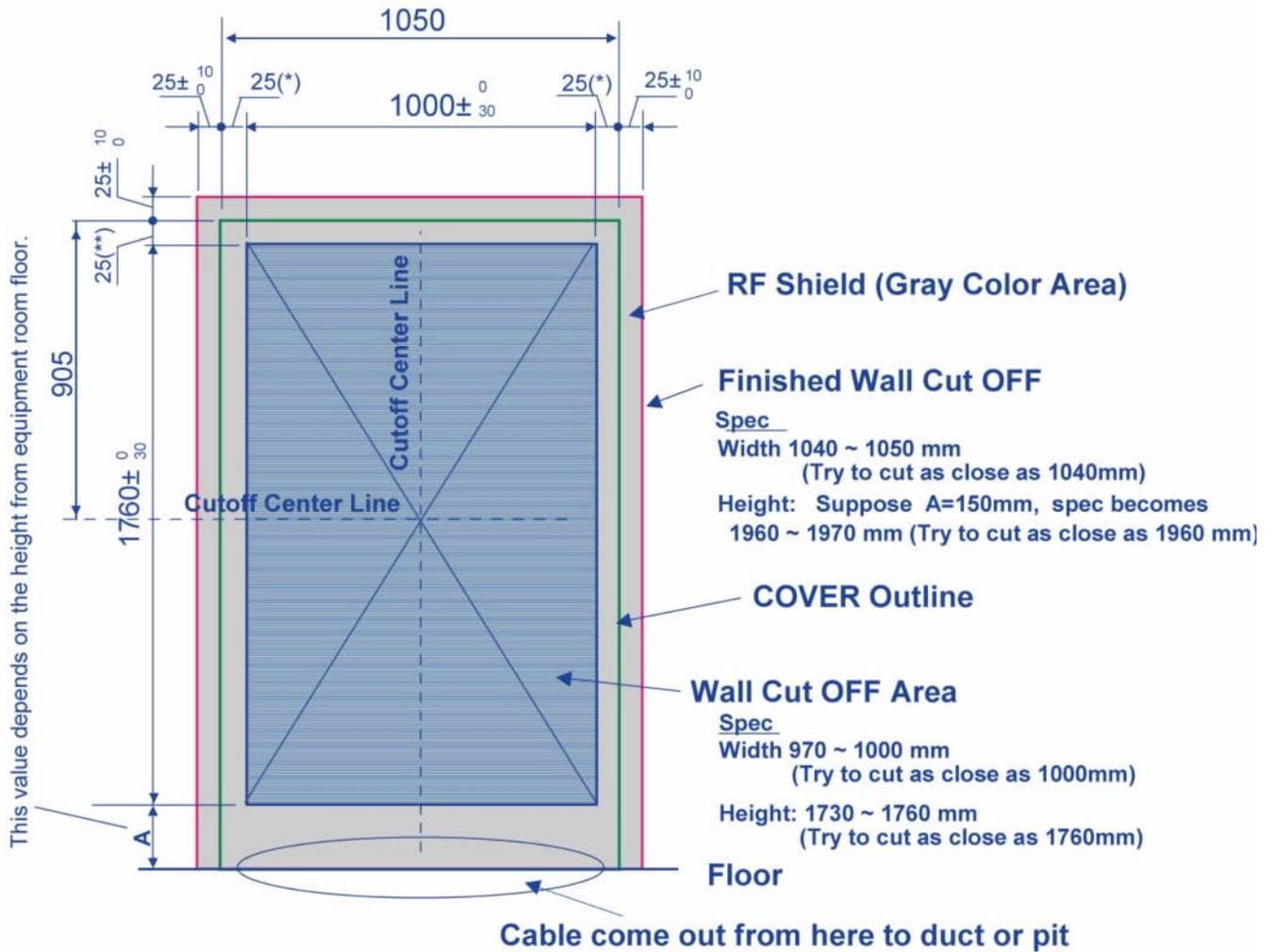


Illustration 8-6 shows wall cutoff detail for System Cabinet (Magnet Room Side).

Illustration 8-6: Wall for System Cabinet Detail (Magnet Room Side)



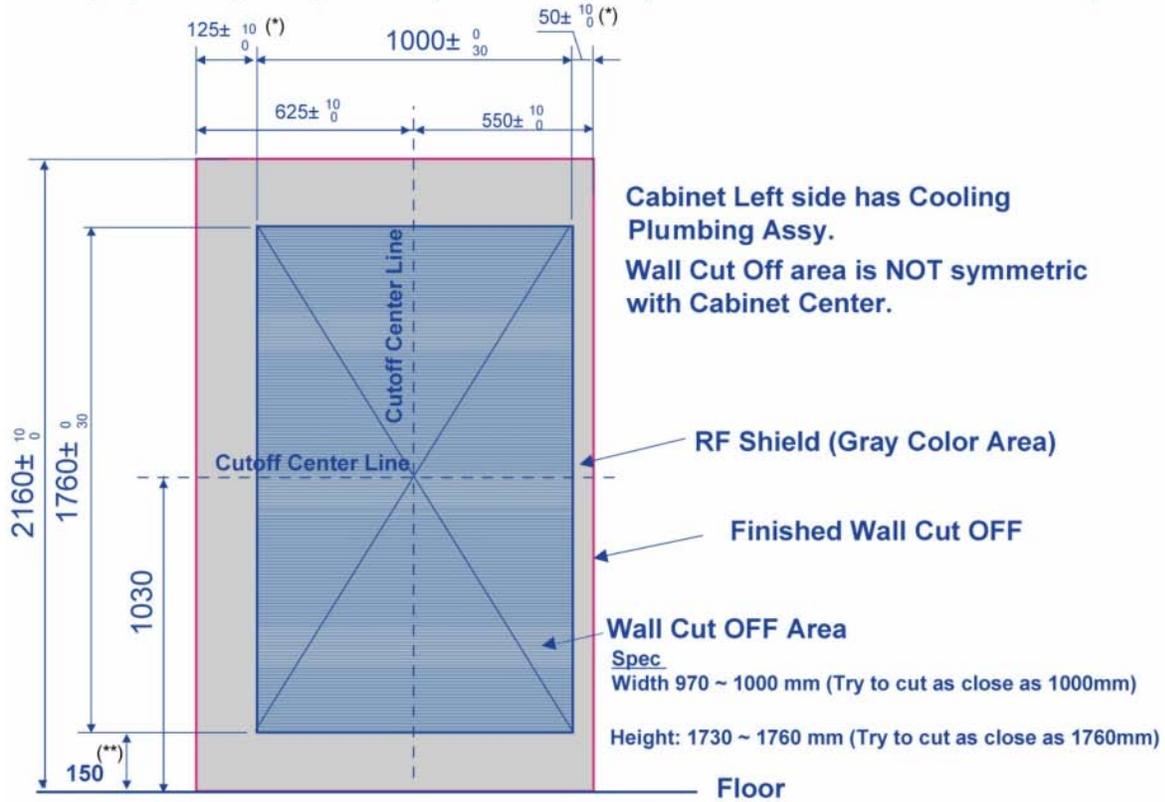
(*): This value is the length when the wall cutoff width is 1000mm

(**): This value is the length when the wall cutoff height is 1760mm

Illustration 8-7 shows wall cutoff detail for System Cabinet (Equipment (or Operator) Room Side).

Illustration 8-7: Wall for System Cabinet Detail (Equipment (or Operator) Room Side)

Equipment(or Operator) Room Side (Wall for Mesh Shield Detail)

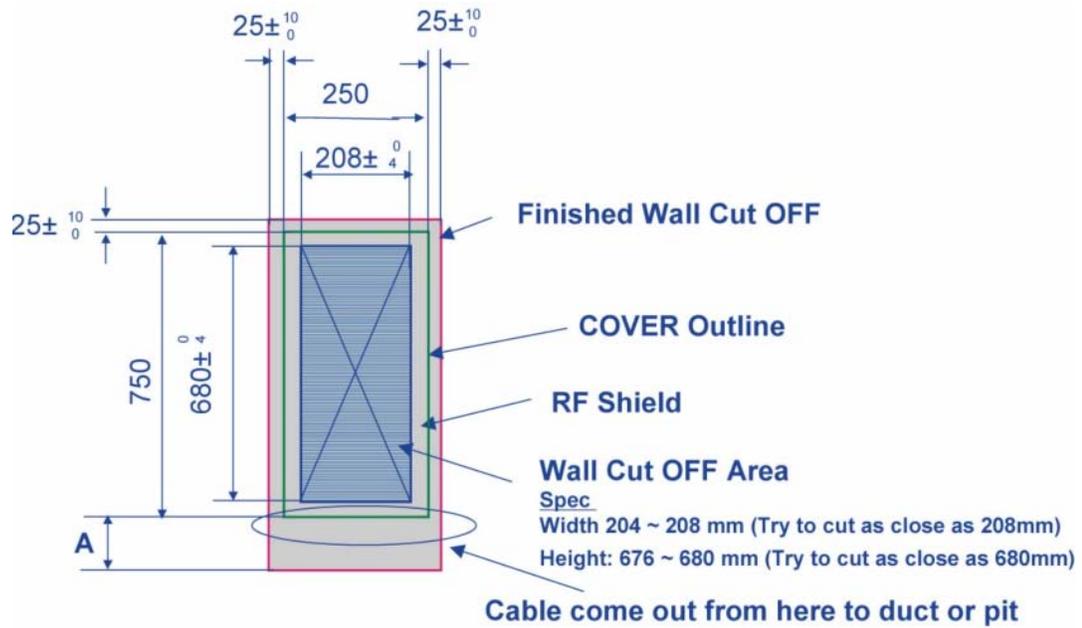


(*): This value is the length when the wall cutoff width is 1000mm

(**): This value is the length when the wall cutoff height is 1760mm

Illustration 8-8 shows wall cutoff detail for Penetration Panel (Magnet Room Side and Equipment (or Operator) Room Side).

Illustration 8-8: Wall for PP Detail (Magnet Room Side and Equipment (or Operator) Room Side)



A: This value is decided according to the site layout.

Illustration 8-9 shows screw location for Mesh Shield and Penetration Panel.

Illustration 8-9: Screw Information Of Mesh Shield and PP

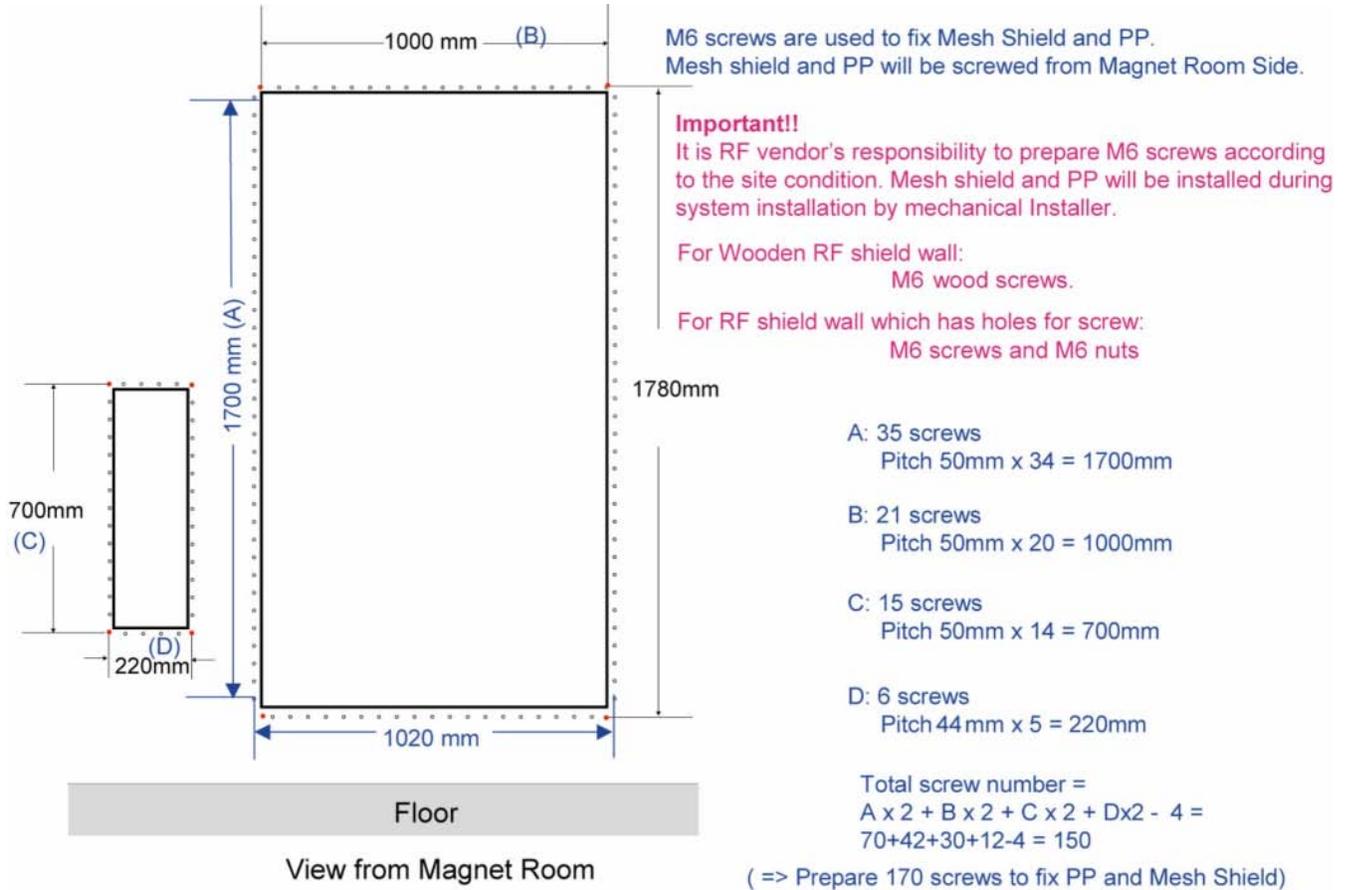
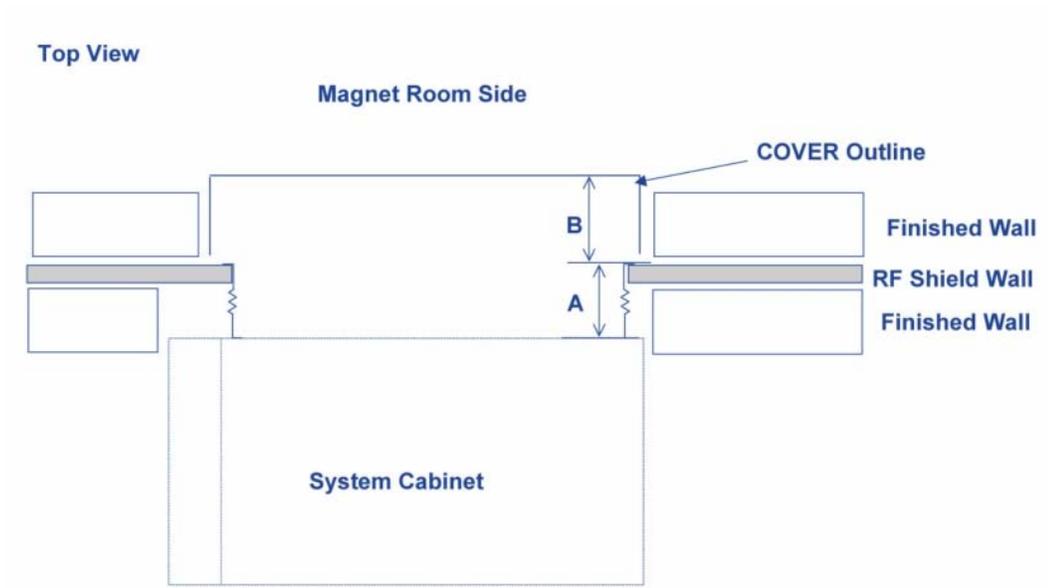


Illustration 8-10 shows Top View of System Cabinet and Wall.

Illustration 8-10: System Cabinet Cover Top View



A: Mesh Shield is adjustable from 110 ~ 120mm

B: Cover is adjustable from 100 ~ 200 mm

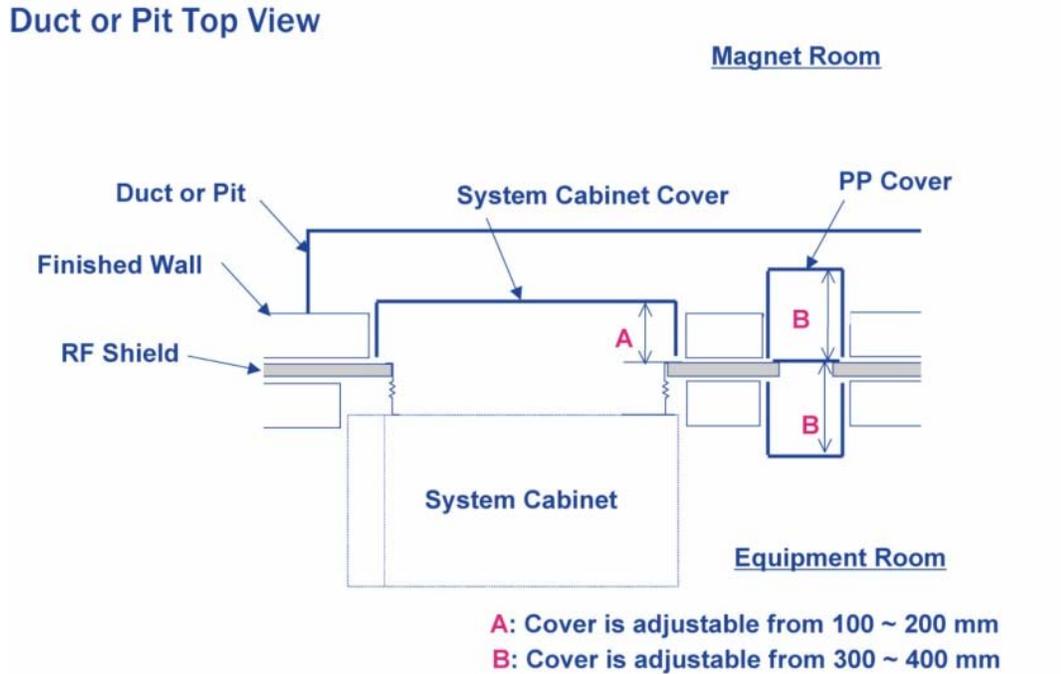
Illustration 8-11 shows Top View of duct or pit.



NOTICE

When cutting the duct or pit for cable routing, make sure the System Cabinet Cover can cover the cutoff for the cable.

Illustration 8-11: Duct or Pit Top View



Notice:

When cutting the Duct or Pit for cable routing, make sure the System Cabinet Cover can cover the cutoff for the cable.

Illustration 8-12: Mesh Shield Installation

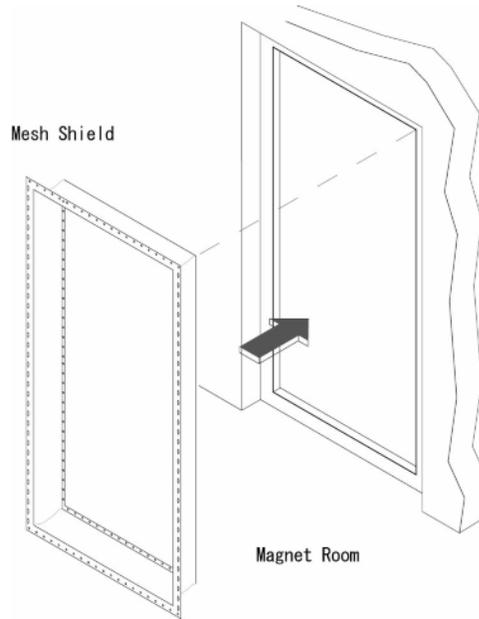
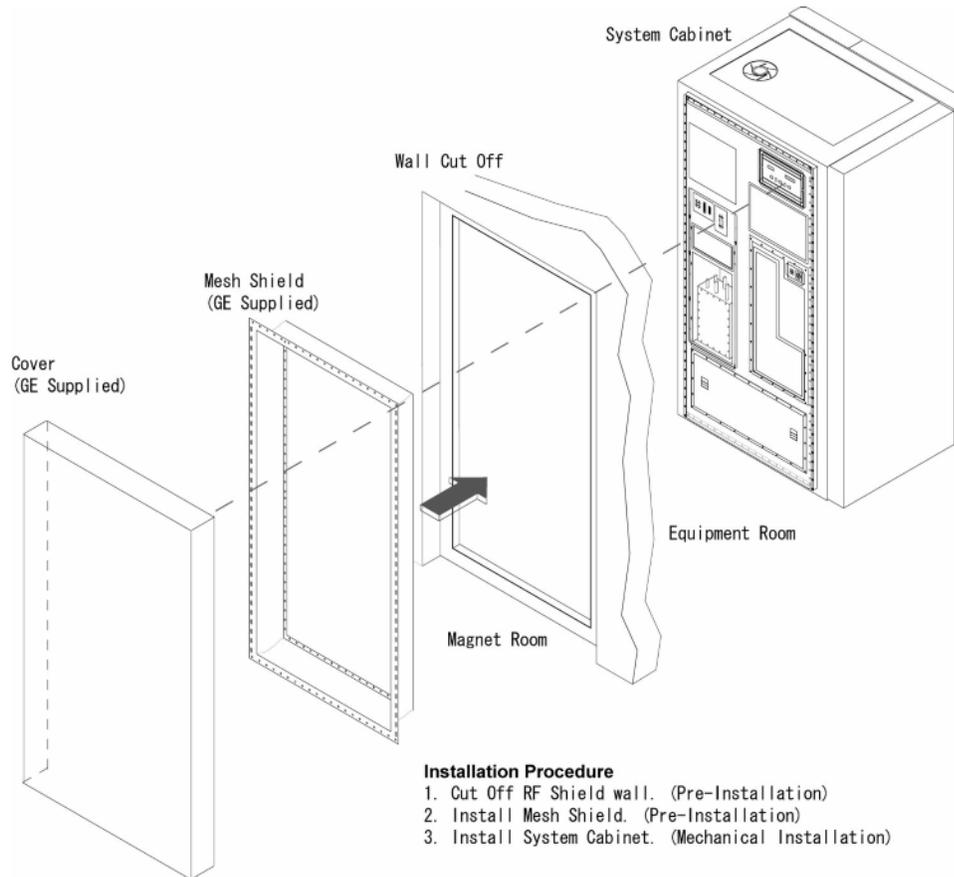


Illustration 8-13: Relationship of Mesh Shield and System Cabinet



6 Physical Considerations

6.1 Introduction

The RF shielded room can be either a free standing shielded structure or a shielded room within an existing room. All styles of RF Shielded Rooms must be electrically isolated from earth ground complying with requirements in [RF Shielded Room Requirements](#).

NOTE: All physical considerations must comply with requirements in [RF Shielded Room Requirements](#) to minimize the possibilities of electrical discharge that can cause RF broadband noise.

6.2 Doors and Other Openings

Shielded room doors are a major source of RFI leaks and must comply with requirements in [RF Shielded Room Requirements](#).

The main door requires a minimum finished opening of 43 in. (1092 mm) to allow for helium dewars and patient tables to pass through the opening. However, a 48 in. (1219 mm) wide door is recommended for easy maneuvering of the Patient Table. Maximum door sill height is 1 in. (25 mm) with a 10 degree maximum threshold inclination.

The magnet delivery into the Magnet/RF Shielded Room requires an access opening into the room which meets the following:

- Wall or ceiling opening to allow sufficient clearance of magnet with rigging equipment, refer to [Chapter 9, Magnet Shipping Considerations](#) for magnet shipping dimensions and consult with customer provided/arranged riggers to determine clearances required for their equipment.

NOTE: Consideration for clear opening dimensions is especially important for sites requiring magnetic shielding.

NOTE: A typical 9 ft wide by 10 ft high removable wall panel or 9 ft by 10 ft ceiling hatch may require a larger opening in the RF Shield wall or ceiling to accommodate panel or hatch mounting hardware.

- Removable panels/hatch mounting and installation must comply with requirements in [RF Shielded Room Requirements](#) for RF Shield integrity and to minimize the possibilities of electrical discharge can cause RF broadband noise.
- Future access may be required for magnet entrance/exit so there should be contingency plans for such situations.

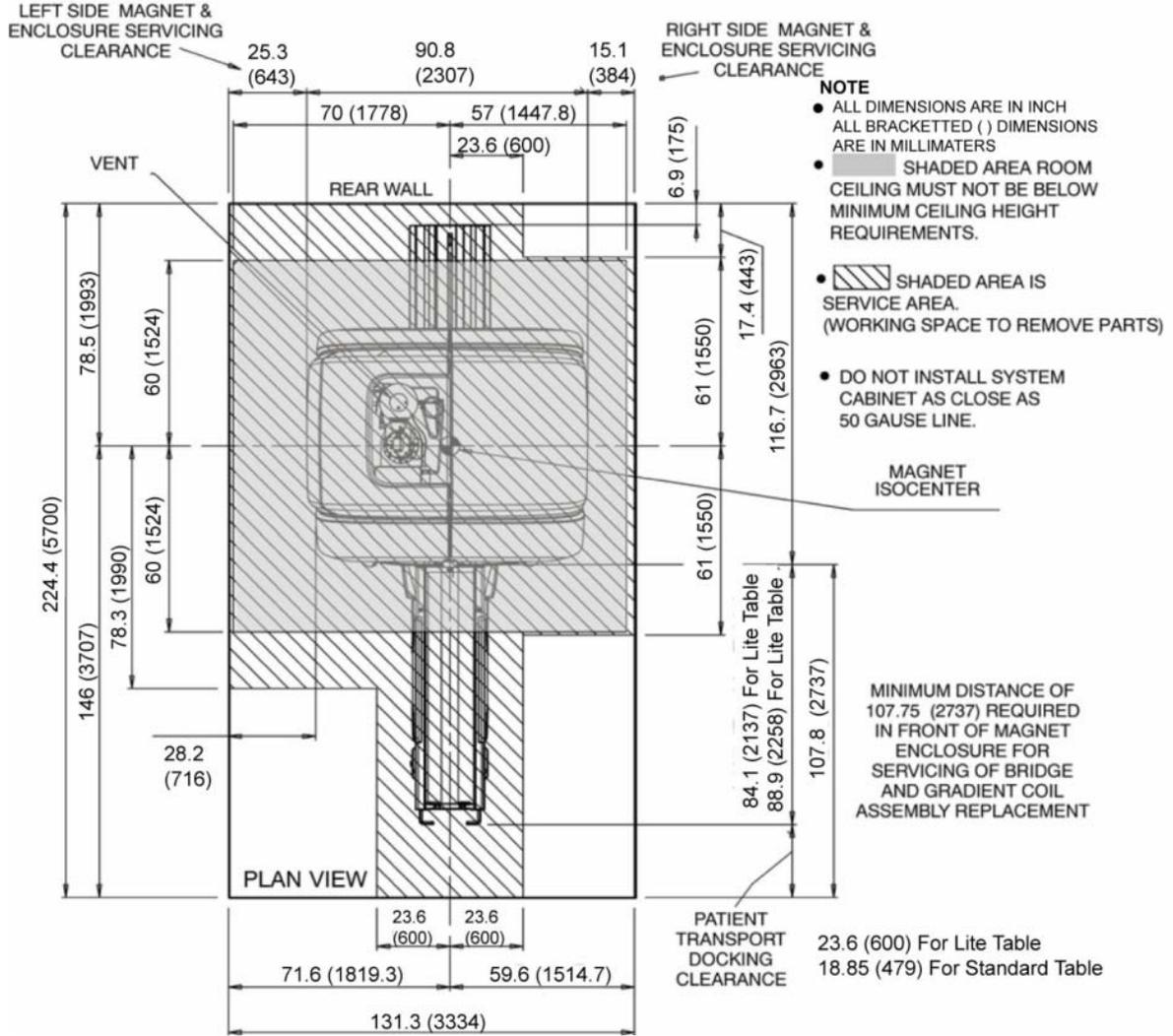
6.3 Ceiling Height

Table 8-4 lists the Magnet Room absolute minimum ceiling height required for servicing the listed magnets. This height is required for the area directly above the magnet. GE Healthcare, Design Center group must be notified of any ceiling dimensions less than ceiling heights stated in Table 8-4 and shown in Illustration 8-14. The Design Center group can be reached at (262) 548-4500.

Table 8-4: Magnet Servicing Ceiling Height Requirements

Magnet Type	Absolute Minimum Ceiling Height *		Comments
	in.	mm	
1.5T LCC	105	2667	Magnet servicing is performed from a platform ladder which is positioned at the Coldhead side of the Magnet. Ceiling height allows for clearance for fill line stinger insertion.
1.5T LCC with Low Ceiling Height Siting Option (M1060SR) installed	98.5	2500	Magnet servicing is performed from a platform ladder which is positioned at the Coldhead side of the Magnet. Ceiling height allows for clearance for insertion of fill line with 7 inch (178 mm) stinger insertion.
Note * Absolute minimum ceiling height values are from magnet room finished floor to fixed ceiling.			

Illustration 8-14: Minimum Ceiling Height for Magnet Servicing



Use of a standard valved helium transfill line and a 250 liter dewar (not more than 70 in. (1778 mm) high) requires a ceiling height of 135.5 in. (3442 mm) for inserting transfill line into the dewar. Note that this need only be a 24 in. (610 mm) square ceiling recess located either in the Magnet Room or in an accessible area near the Magnet Room where the transfill line can be inserted into the dewar. A 500 liter dewar (not more than 73 in. (1854 mm) high) requires a ceiling height of 138 in. (3505 mm) for the same process.

If the helium transfill requirements cannot be satisfied in or near the Magnet Room, consider a location outside the building or on a loading dock. The standard valved transfill line, after insertion into either a 500 or 250 liter dewar, will fit through 79 in. (2007 mm) high doorways and hallways. Provide free access from the dewar location to the magnet. If elevators are to be used along cryogen delivery route, verify that elevator dimensions and weight capacity is sufficient to handle the cryogen dewars. Also, elevator must be dedicated with restricted access during cryogen transport (will not allow stops between initial start and final floor destination).

6.4 Walls

It is recommended that walls be covered to protect RF material and to add to the aesthetics of the room for patient comfort. Fire retarding material must be used per building codes. Consult RF shield room vendor for RF shielding service requirements prior to covering RF walls. Removable wall covering may be needed if periodic RF shield servicing is required to maintain RF integrity. For wall designs impacts to sound quality improvements within the Magnet Room and address airbourne acoustics to areas outside the Magnet Room, refer to [Chapter 12, Acoustic Design Guidelines](#).

NOTE: Walls materials and installation including all electrical and mechanical connections, mounting hardware, and installation must comply with the requirements in [RF Shielded Room Requirements](#) to minimize the possibilities of electrical discharge can cause RF broadband noise.

The recommended patient viewing window dimensions are 48 in. wide by 42 in. high (1219 mm x 1067 mm). The location of the window is dependent on the position of Operator Workspace position. For potential acoustic impact of window location refer to [Chapter 12, Acoustic Design Guidelines](#).

NOTE: The operator at the Operator Workspace must be able to view the patient during a scan.

6.5 Magnet Room Floors

Refer to [Table 8-5](#) for Magnet Room floor requirements and comments.

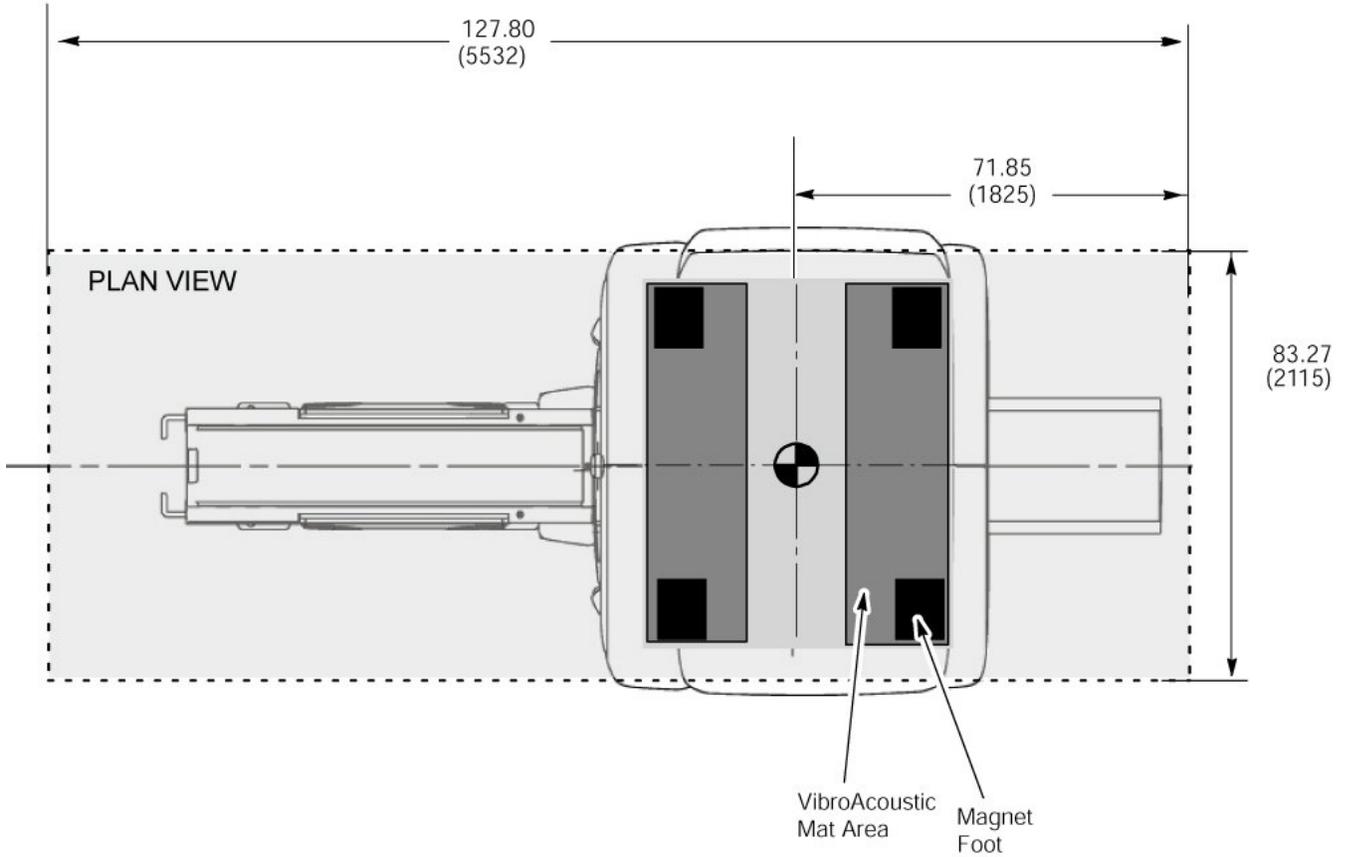
Table 8-5: Magnet Room Floor Requirements And Comments

Requirements
<ol style="list-style-type: none"> 1. The floor/flooring (i.e. structural, sub-floor and finished flooring) must meet local and national codes. 2. The floor under the Magnet in a 10 ft x 12 ft (3.048 m x 3.658 m) area must not be fabricated from magnetic materials per Magnet Room Floors Magnetic Properties in Chapter 5, Construction Materials. 3. Floor/flooring must support the weight of equipment during system installation and throughout the operation and Service life. 4. Magnet, Enclosure, and Patient Table areas (shown shaded in Illustration 8-15) must be level and flat defined as less than 0.3125 in. (8 mm) between high and low spots in the area. 5. For non-VibroAcoustic Damping Option sites: RF Shield Vendor to provide Aluminum, Brass or Stainless Steel plates to support the Magnet feet (non-compressible material to maintain the depth and level requirements stated in preceding bullets).: 6. Metal access floor tiles are NOT allowed to be used anywhere in the Magnet Room. 7. Rear Pedestal floor support: <ol style="list-style-type: none"> a. The floor under the Rear Pedestal must support 550 lbs (250 kg) distributed across the 4 leveling feet (1.2 meter). b. The Rear Pedestal leveling feet must be positioned on one solid floor member, no joints or seams are allowed. 8. The Magnet Room finished floor surface resistance must measure between 10E6 ohms and 10E9 ohms. <ol style="list-style-type: none"> a. The finished floor grounding device must be fastened/secured to the RF Shield Common Ground Stud. b. No carpets, antistatic wax or spray on treatments are allowed for use on the magnet room finished flooring. 9. Electrically conductive materials utilized must comply with requirements in RF Shielded Room Requirements to minimize the possibilities of electrical discharge which can cause RF broadband noise. 10. The finished floor needs to be water resistant and protect the RF/Magnetic Shield and subfloor from possible water damage.
Comments
<ul style="list-style-type: none"> • MR System Interconnection cables are FT4 or equivalent rated; not plenum rated. • The VibroAcoustic Damping Option mats must be continuously supported to function per design. Failure to meet all levelness requirements will result in excessive settlement of the Magnet and mats contributing to mis-alignment of the Magnet Enclosure, Patient Table and Table Docking Assembly. • The flooring grounding device and fastener/securing equipment are supplied by the customer or customer contractor and must be installed as the manufacturer defines. Local and national codes must be met when grounding the floor system to the RF Ground Stud.

Illustration 8-15: Magnet Room Floor Levelness Area

Note

All dimensions are in inches. All bracket () dimensions are in millimeters.



7 Anchor Hardware Requirements

7.1 Anchor Hardware For MR Equipment Inside RF Shield

7.1.1 Introduction

The following components must be anchored to the floor:

- Blower Box
- Dock
- Magnet (without Vibro-Acoustic dampening option)

An RF Shielded Room is required per [RF Shielded Room Requirements](#) and the mounting of MR equipment located inside the RF Shield must comply with the RF Shield requirements.

Anchors are installed into the Magnet Room floor to provide a connection point to securely mount equipment. Improper installation of anchors can introduce RF issues (discrete and/or broadband) as well as secondary ground issues. Refer to [RF Shielded Room Requirements](#) for potential RF issues and RF Shielded Room requirements.

When the anchors penetrate the RF shield then the installation of the anchors must meet the requirements of [RF Shielded Room Requirements](#). Refer to [RF Shield Integrity](#) and [Electrical Isolation](#) for additional information.



NOTICE

Customers choosing to install the Magnet using the VibroAcoustic Damping Option (M1060MA) are not required to set anchors into the structural floor directly under the magnet feet. However, other system equipment anchors defined in the following sections are still required.

7.1.2 Customer Responsibilities

The Customer is responsible for the following tasks:

- Contract with RF Shield Room vendor, structural engineer, and architect to design the equipment anchor hardware to meet the GE specifications, refer to [RF Shielded Room Requirements](#) requirements table, [Physical Characteristics](#), and [Anchor Location And Installation](#).

NOTE: The need for Blower Box anchors must be planned in advance to allow the RF Shield vendor to include the cost in their bid.

- Obtain any and all approvals necessary for the construction of equipment support and seismic anchoring. The customer needs to obtain a copy of building inspector's (inspection) report and approval of the anchor method, maintain these documents with the site documentation.
- Coordinate equipment anchor methods and anchor locations with the contracted RF Shield Room vendor, structural engineer, and architect to prevent RF leaks and secondary grounding problems.

7.1.3 RF Shield Room Vendor Responsibilities

The RF Shield Room vendor is responsible for the following tasks:

- Design the equipment anchor hardware to meet the GE specifications, refer to [RF Shielded Room Requirements](#) requirements table, [Physical Characteristics](#), and [Anchor Location And Installation](#).
- Procurement of commercially available anchors, bolts / removable rods, and fastening hardware required for equipment listed in [Physical Characteristics](#).



NOTICE

The RF Shield Room vendor **MUST** supply torque specifications for all procured two part type anchors, BOLTS / REMOVABLE RODS, and fastening hardware to meet the clamping force specified for each piece of equipment listed in [Physical Characteristics](#).

- Define the anchor torque/method required to achieve the specified clamping force (tension), refer to [Physical Characteristics](#). The torque requirement to be provided to the customer for use during magnet installation.
- Layout and installation of the equipment anchors (create own template from GE supplied information) Coordination with Building Contractor/Architect may be necessary to prevent interference with rebar or structural steel that would cause a secondary ground path through the anchor.
 - Coordinate with GE Service to locate magnet isocenter and equipment mounting. RF Shield Room vendor must be present when GE Service identifies magnet isocenter location (to maximize the accuracy of the location).
 - Coordinate with GE Service to make sure site requires Magnet anchor bolts (i.e VibroAcoustic Damping Option (M1060MA) not planned to be installed).
 - If VibroAcoustic Damping Option (M1060MA) not planned to be installed then anchors for Magnet shall be installed prior to magnet installation to allow time to address any issues that may arise.
 - Dock Assembly Anchor shall be installed at the anchor location determined by GE Service using the Dock Assembly aligned to the Magnet.
 - If the Blower Box is secured to the finished floor and the anchor hardware penetrates the RF shield then the RF Shield Vendor must install the anchors prior to system equipment delivery.
- Perform pull test on all anchors to confirm the specified clamping force (tension) can be met, refer to [Clamping Force \(Tension\) and Pull Test](#). A copy of the test results must be provided to the customer (customer to maintain copy with the site documentation).
- Perform ground impedance (electrical isolation) test on installed anchors, refer to [Electrical Isolation](#).
- Perform RF integrity test per [Chapter 12, RF Shielded Enclosure Test Guideline](#).
- Provide copy of ground impedance and RF room integrity tests to the customer to be maintained with the site documentation.

7.1.4 GE Healthcare Responsibilities

GE Healthcare is responsible for the following tasks:

- GE Project Manager, Installations to provide equipment dimensions drawings showing equipment mounting locations to the RF Shield Room vendor and review the anchor method prior to anchor installation.

- GE Service to assist RF Shield Room vendor by locating magnet isocenter during layout of equipment anchors. RF Shield Room vendor to be present when GE Service identifies magnet isocenter location to maximize the accuracy of the location.
- GE Service to inspect and verify the anchor location is correct and obtain the anchoring hardware from the RF Shield Room vendor prior to equipment delivery.
- GE Service to carefully inspect the RF seal (electrical connectivity) of the anchor and bolts/rods to the RF Shield (i.e. the fibrous washer or equivalent device is in place).
- GE Service to work with riggers to secure Magnet to anchors at time of delivery and installation.
- The Dock Assembly anchor location is determined by GE Service using the Dock Assembly aligned to the Magnet. (RF Shield Room Vendor is responsible for installing the two part anchor.)

Refer to [Physical Characteristics](#) for equipment type and seismic anchor characteristics.

7.2 Physical Characteristics

NOTE: The LCC Magnet installed with the VibroAcoustic Damping Option (M1060MA) has the VibroAcoustic Damping mats resting directly on the floor. The LCC Magnet is leveled and bolted to the VibroAcoustic Damping mats stainless steel top plate. The VibroAcoustic Damping mats do not require anchors into the Magnet Room floor in non-seismic areas.

7.2.1 Anchor Requirements and Material Properties

Anchor hardware must meet the following requirements:

- Two part type anchor assembly (female and male)
 - The female anchor can be expansion or epoxy type (must be compliant with local and national code and regulation)
 - The male anchor can be either a bolt or threaded rod with appropriate sized nut (rod must be completely removable, not epoxyed or cemented in place)

NOTE: All anchors must be the two part type that meet the design requirements to allow for future serviceability. **No exceptions allowed.**

- Able to achieve clamping force (tension) requirement for the equipment to be anchored, refer to [Table 8-6](#).
- Non-magnetic and electrically conductive (to allow it to be electrically connected to the Room's RF Shield at the point of penetration)
- Compatible with the material properties of the RF Shield and not produce galvanic corrosion due to dis-similar metals
- Be completely removable for Service activities and equipment installation
- Be commercially procured
- Is approved by the local building inspector.

7.2.2 Design of Anchor Assembly

The following factors contribute to the anchor selection:

- Embedment depth (affects the length of the bolt/removable rod) and properties of material in which the anchor will be embedded
- Floor thickness including RF Shield floor and Magnet Room finished floor
- Equipment base thickness and any spacers required under the base
- Equipment base clearance for protrusion of bolt/rod inside the base
- Anchor diameter:
 - Magnet anchor bolt/removable rod diameter: minimum 0.625 in. (M16) and maximum 1.25 in. (M32)
 - Dock and Blower Box: refer to [Table 8-6](#)
- Size of the hole in the equipment base (affects the diameter of the bolt/removable rod)
- Clamping force (tension) requirement for the equipment, refer to [Table 8-6](#)
- Seismic codes (affect the length and diameter of the bolt/removable rod and anchor size)

Refer to [Table 8-8](#) for Equipment Characteristics.

Table 8-6: Equipment Clamping Force (Tension) Requirements

Equipment Type	Clamping Force (Tension) To The Floor Applied To Each Anchor	
	See Note 1	
	lbs	N
1.5T LCC Magnet without VibroAcoustic Damping Option (See Note 2 & 3)	2,500 ± 200	11,100 ± 900
Dock Assembly for 1.5T LCC Magnet	600 ± 100	2700 ± 450
Blower Box (See Note 4)	100 ± 10	450 ± 45
<p>Note</p> <ol style="list-style-type: none"> 1. The RF Screen Room Vendor must perform a pull test on each anchor, equal to the clamping force (tension) required for the equipment, prior to equipment delivery. A copy of the pull test results, anchor ground impedance measurements and building inspection certification must be given to given to the customer to be maintained with the site documentation. 2. Compressible material must not be present in the recessed floor area under the Magnet, refer to Table 8-7 and Illustration 8-16. The clamping force (tension) must be maintained for the equipment over the life of the product. 3. All four feet of the magnet must be anchored to the floor. The anchor hole openings in the magnet base are to be used to anchor the magnet. 4. The Blower Box must be securely mounted to the solid floor in the Magnet Room or a support shelf on the Magnet Room wall or ceiling with support provided under the Blower Box. The Blower Box must not be on a raised floor section within the Magnet Room. If the Blower Box is secured to the finished floor and the anchor hardware penetrates the RF shield then the RF Shield Vendor must install the anchors prior to system equipment delivery. The need for Blower Box anchors must be planned in advance to allow the RF Shield vendor to include the cost in their bid. 		

Table 8-7: Magnet Load Pattern Without VibroAcoustic Damping Option

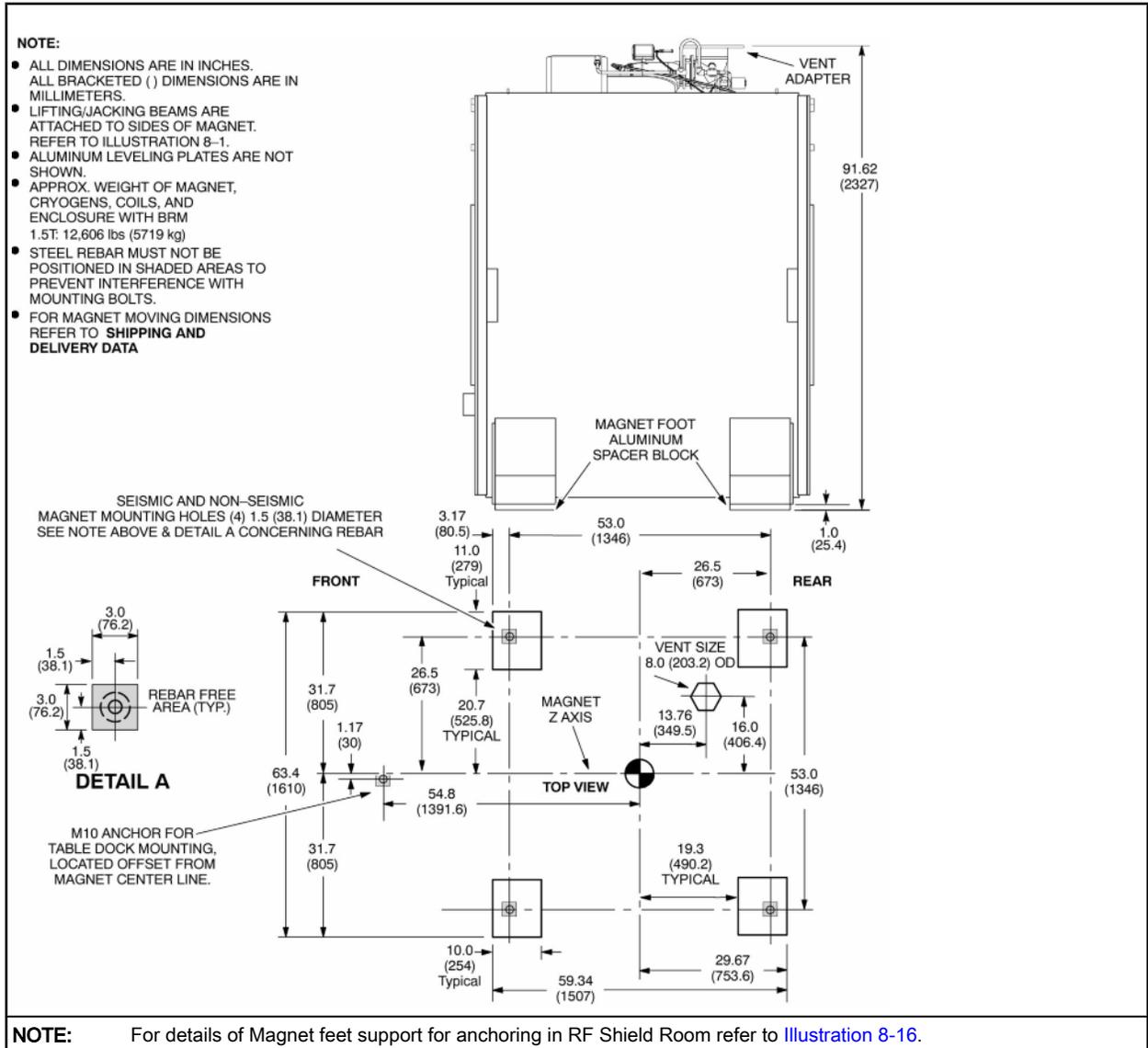
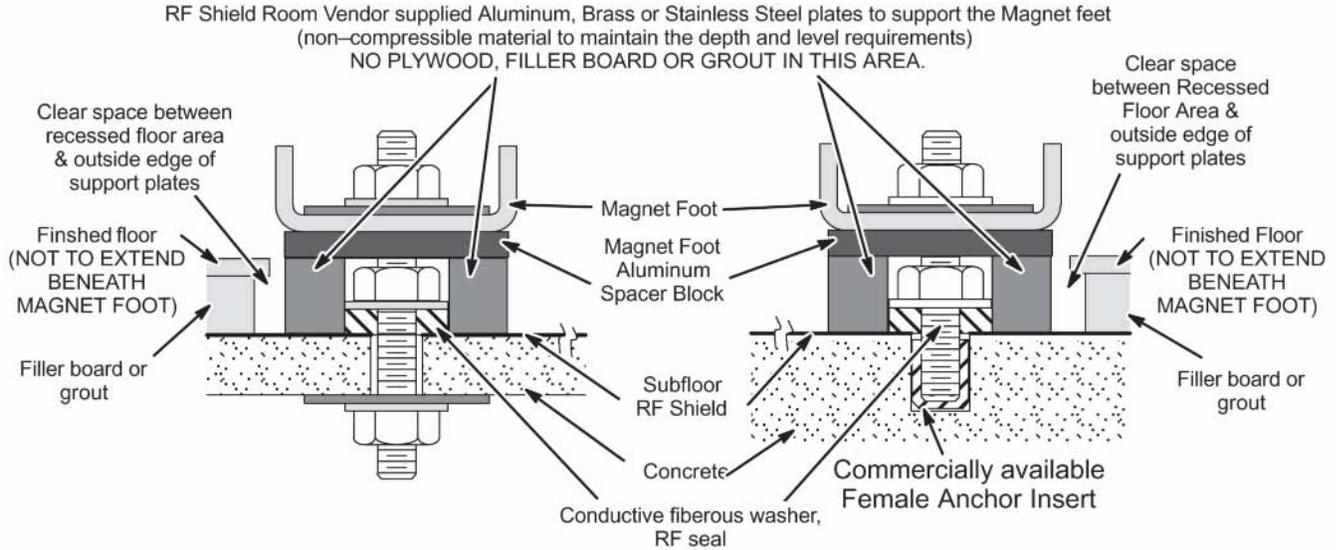


Illustration 8-16: RF Shield Room Anchor Details



Note: For sites with RF Shield on top of subfloor, the RF Shield needs to be recessed to the concrete level to provide a proper RF Seal.

NOTE: When the Magnet is installed with the VibroAcoustic Damping Option then the Magnet is bolted to the VibroAcoustic Damping Option mats which set on the recessed floor area for non-seismic zones. For VibroAcoustic Damping Option mounting in seismic zones refer to seismic drawings available on request from your local GE Healthcare Project Manager Installations.

Table 8-8: Equipment Characteristics (See Note 1 in this Table)

Equipment Type	Equipment Mounting Base Thickness in. (mm)	Clearance Hole In Equipment Base in. (mm)	Maximum Clearance Above Equipment Base in. (mm) See Note 2	Seismic Requirement Pre-Approved By OSHPD For Bolt Or Stud Diameter in. (mm) See Note 3	Equipment Mounting Illustration
1.5T LCC Magnet without VibroAcoustic Damping Option See Note 4	1.75 (44) See Note 5	1.5 (38)	2.5 (64)	1.0 (M24)	Table 8-7 & Illustration 8-16
Dock Assembly for LCC Magnet	0.75 (20)	0.43 (11)	2.0 (50)	Pre-approval not required. Select anchor/stud to clamping force (tension).	Table 8-7
Blower Box See Note 6	0.25 (6)	0.25 (6)	0.5 (13)	Pre-approval not required. Select anchor/stud to clamping force (tension).	Blower Box

Equipment Type	Equipment Mounting Base Thickness in. (mm)	Clearance Hole In Equipment Base in. (mm)	Maximum Clearance Above Equipment Base in. (mm) See Note 2	Seismic Requirement Pre-Approved By OSHPD For Bolt Or Stud Diameter in. (mm) See Note 3	Equipment Mounting Illustration
<p>Notes</p> <ol style="list-style-type: none"> 1. All equipment mounting methods and installation must meet requirements in RF Shielded Room Requirements. 2. Maximum Clearance Above Equipment Base is the dimension for protrusion of the bolt or rod inside the equipment base including clearance for tools to tighten hardware to meet specifications in Table 8-6. 3. Seismic codes do not allow for any gap between the bolt or rod and clearance hole in the base of the equipment. In California, USA all anchor hardware designs must be submitted to the Office of Statewide Health Planning and Development (OSHPD) for pre-approval. For all other states, provinces or countries, plans must be submitted to the local planning authority (where seismic codes apply). 4. When the VibroAcoustic Damping Option is not installed then all four feet of the Magnet must be bolted to the floor. The bolt hole openings in the Magnet base are to be used to anchor the Magnet. 5. Magnet mounting base thickness includes the 1 inch (25 mm) foot block required to maintain the Magnet Center Line Height dimension as defined in Chapter 3, Magnet and Enclosure Magnet Enclosure Front And Rear Views illustration. 6. The Blower Box must be securely mounted to the solid floor in the Magnet Room or a support shelf on the Magnet Room wall or ceiling with support provided under the Blower Box. The Blower Box must not be on a raised floor section within the Magnet Room. If the Blower Box is secured to the finished floor and the anchor hardware penetrates the RF shield then the RF Shield Vendor must install the anchors prior to system equipment delivery. The need for Blower Box anchors must be planned in advance to allow the RF Shield vendor to include the cost in their bid. 					

7.3 Anchor Location And Installation



NOTICE

Anchor hardware must avoid direct contact with rebar or wire mesh located in the building or Magnet Room floor to avoid secondary ground planes and/or RF issues (discrete and/or broadband), refer to Ground requirements in RF Shielded Room Requirements table in [RF Shielded Room Requirements](#).

The exact location for installing the Magnet anchors is determined by dimensional footprint drawings for the MR equipment to be installed. The Design Center group at GE Healthcare will provide to the RF Shield Room Vendor the dimensional drawing showing all anchor locations. The drawing can be issued in either hard copy or electronic format. The RF Shield Room Vendor is responsible for supplying their own template to precisely mark the Magnet anchor locations within the room.

Dock Assembly Anchor shall be installed at the anchor location determined by GE Service using the Dock Assembly aligned to the Magnet. RF Shield Room Vendor is responsible for installing the two part anchor.

Coordination between the RF Shield Room Vendor and Building Contractor/Architect may be necessary to mark the location of the Magnet anchors to prevent interference with rebar or structural steel. A re-arrangement of the room may be necessary to ensure ground isolation, refer to Ground requirements in RF Shielded Room Requirements table [RF Shielded Room Requirements](#).

Refer to equipment dimensional illustration references in the Equipment Characteristics table in [Physical Characteristics](#).

7.4 Clamping Force (Tension) and Pull Test

1. Anchors which meet requirements in [Physical Characteristics](#) must be installed per [Anchor Location And Installation](#).
2. Each anchor must meet the clamping force (tension) requirement defined in [Physical Characteristics](#).

NOTE: The equipment must be clamped directly to the floor and the entire equipment base must maintain full contact to the floor per [Physical Characteristics](#) requirements.

3. A pull test equal to the clamping force (tension) must be performed by the RF Shield Room Vendor prior to the equipment installation. The test results indicating the torque required to achieve the specified clamping force (tension) must be recorded by RF Shield Room Vendor and the customer to maintain a copy of this report with the site documentation.

7.5 RF Shield Integrity

The anchor hardware must maintain RF shield integrity. This is accomplished by electrically sealing the stud at the penetration point on the RF shield. The method by which the electrical contact is made must take into account any stretch in the stud resulting from the applied clamping force (tension). A fibrous washer or equivalent will provide a proper RF seal where a solid flat washer could produce an RF leak and introduce artifacts into the MR images. The RF room test should result in a specific attenuation at the operating frequency of the system under the following conditions:

1. Blank Penetration Panel installed
2. Anchor hardware installed
3. Electrical connection made between the anchor stud and the RF shield.

Refer to Appendix [Chapter 12, RF Shielded Enclosure Test Guideline](#).

7.6 Electrical Isolation

The anchor hardware must not provide a secondary ground path for the RF Shield Room, refer to [Table 8-9](#) for anchor hardware electrical isolation requirements and recommendations.

Table 8-9: Anchor Hardware Electrical Isolation Requirements & Recommendations

Requirements	Recommendations
<ul style="list-style-type: none"> • Ground Isolation: 1,000 ohms or greater (refer to RF Shielded Room Requirements requirements table) • Secondary Ground (Other grounds that connect the outside of the RF Shield Room to earth grounds are called secondary grounds.): Secondary grounds must not compromise Ground Isolation of 1,000 ohms or greater. (Refer to RF Shielded Room Requirements requirements table) <p>NOTE: If the result is less than 100 ohms then it is very likely the anchor has made contact to steel rebar or wire mesh. In this case the steel in the floor will need to be removed or the anchors will need to be relocated. In either case GE Healthcare must be notified and a retest performed after the corrective action is taken.</p> <ul style="list-style-type: none"> • The electrical isolation test results must be recorded by RF Shield Room Vendor and the information forwarded to the customer to be maintained with the site documentation. 	<ul style="list-style-type: none"> • Electrical isolation test of each anchor and bolt/rod should be performed prior to Magnet placement.

7.7 Example - Select Magnet Anchor Size

The following is an example to illustration the selection of proper anchors to install a Magnet into a building structure with 2000 psi (13.8 MPa) concrete. For this example the area is not under seismic requirements.

- Determine magnet clamping force (tension) by referring to requirements in [Clamping Force \(Tension\) and Pull Test](#).
2500 lbs + 200 lbs = 2700 lbs or 11,100 N + 900 N = 12,000 N
- Refer to [Illustration 8-17](#) or [Illustration 8-18](#) (examples of anchor vendor catalogs) to select anchor diameter and embedment which meets the clamping force (tension) determined in Step 1.
Diameter : Min. 0.625 inch Max. 1.25 inch
For 8 inch embedment select 3/4 inch diameter
For 4.5 inch embedment select 1 inch diameter
or
Diameter : Min. M16 Max. M32
For 130 mm embedment select M20 diameter
For 114 mm embedment select M24 diameter
- The vendor instructions and torque to the maximum recommended level for the anchor selected in Step 2 must be provided to the RF Shield Room vendor for proper installation of the anchor and equipment.

Illustration 8-17: EXAMPLE OF ENGLISH UNITS STAINLESS STEEL ANCHOR ALLOWABLE LOADS IN CONCRETE

ANCHOR DIAMETER in. (mm) See Note 1	EMBEDMENT DEPTH in. (mm)	2000 psi (13.8 MPa)		3000 psi (20.7 MPa)		4000 psi (27.6 MPa)		6000 psi (41.4 MPa)	
		TENSION lb (kN)	SHEAR lb (kN)	TENSION lb (kN)	SHEAR lb (kN)	TENSION lb (kN)	SHEAR lb (kN)	TENSION lb (kN)	SHEAR lb (kN)
5/8 (15.9)	2 3/4 (70)	1250 (5.6)	2800 (12.5)	1600 (7.1)	3070 (13.7)	1810 (8.1)	3330 (14.8)	1920 (8.5)	3330 (12.5)
	4 (102)	1870 (8.3)	3330 (14.8)	2400 (10.7)	3330 (14.8)	2930 (13.0)	3330 (14.8)	3200 (14.2)	3330 (12.5)
	7 (178)	2500 (11.2)	3330 (14.8)	3010 (13.4)	3330 (14.8)	3650 (16.2)	3330 (14.8)	3650 (16.2)	3330 (12.5)
3/4 (19.1)	3 1/4 (83)	1550 (6.9)	2880 (12.8)	1950 (8.7)	3310 (14.7)	2350 (10.5)	3730 (16.6)	2610 (11.6)	4800 (21.4)
	4 3/4 (121)	2510 (11.2)	4510 (20.1)	3250 (14.5)	4650 (20.7)	3870 (17.2)	4800 (21.4)	4670 (20.8)	4800 (21.4)
	8 (203)	2930 (13.0)	4800 (21.4)	3870 (17.2)	4800 (21.4)	4530 (20.2)	4800 (21.4)	5120 (22.8)	4800 (21.4)
1 (25.4)	4 1/2 (114)	3120 (13.9)	6080 (27.0)	3870 (17.2)	6770 (30.1)	4610 (20.5)	7470 (33.2)	4800 (21.4)	7470 (33.2)
	6 (152)	4400 (19.6)	7470 (33.2)	6400 (28.5)	7470 (33.2)	7200 (32.0)	7470 (33.2)	7330 (32.6)	7470 (33.2)
	9 (229)	5600 (24.9)	7470 (33.2)	8000 (35.59)	7470 (33.2)	9390 (41.77)	7470 (33.2)	9390 (41.8)	7470 (33.2)

Note 1 All shaded values fail to meet the clamping force (tension), therefore are not acceptable anchors.

Illustration 8-18: EXAMPLE OF METRIC STAINLESS STEEL ANCHOR ALLOWABLE LOADS IN CONCRETE

ANCHOR DIAMETER See Note 1	EMBEDMENT DEPTH mm (in.)	13.8 MPa (2000 psi)		20.7 MPa (3000 psi)		27.6 MPa (4000 psi)		41.4 MPa (6000 psi)	
		TENSION kN (lb)	SHEAR kN (lb)	TENSION kN (lb)	SHEAR kN (lb)	TENSION kN (lb)	SHEAR kN (lb)	TENSION kN (lb)	SHEAR kN (lb)
M16	105 (4 1/8)	11.2 (2500)	25.1 (5650)	20.9 (4705)	39.9 (8965)	24.2 (5450)	10125 (45.0)	6900 (30.7)	10550 (46.9)
M20	130 (5 1/8)	25.1 (5650)	52.9 (11900)	30.7 (6910)	58.7 (13195)	36.4 (8175)	14490 (64.5)	10005 (44.5)	14490 (64.5)
M24	155 (6 1/8)	30.0 (6735)	61.2 (13760)	36.9 (8300)	70.5 (15855)	43.9 (9860)	29.8 (17950)	57.7 (12980)	95.6 (21490)

Note 1 All shaded values fail to meet the clamping force (tension), therefore are not acceptable anchors.

8 Magnet Room Equipment Mounting

8.1 Magnet Rundown Unit (MS4)

The Magnet Rundown Unit should be mounted 60 in. (1524 mm) above the Magnet Room floor near the front of the magnet enclosure but outside the 200 gauss zone.

8.2 Emergency Off Buttons

Customer supplied emergency off buttons to be located near each room exit including magnet and equipment rooms. These buttons must be clearly labeled, "Emergency Off". Refer to [Chapter 6, Emergency Power](#).

8.3 Remote Oxygen Sensor Module (OM3) - Optional

The Remote Oxygen Sensor Module (if option ordered) must be mounted approximately 60 in. (1524 mm) above the Magnet Room floor near the front of the magnet enclosure.

9 RF Door Switch

RF shielded room vendor must supply and install RF door switches on all RF shielded doors. These switches must be wired in series and a GE supplied cable (two loose lead conductors) will attach to one door switch. RF switches must be rated for 24 volts at 750 milliamperes maximum and the switches must be in the open position when the doors are open (switch contacts close when the doors are completely closed).

10 Emergency Exit

Emergency exiting from the Magnet Room is to be specified by the customer's architect and contractor. Such measures as an out swinging door, emergency door latch release, easily removed window, or other measures must be designed into the room. Emergency exit instructions must be permanently and prominently mounted near the door and/or window.

11 Room Ventilation Switch

Placement of the room ventilation switch should be near the Magnet Room door and is the responsibility of the architect and mechanical contractor.

Chapter 9 Shipping and Delivery Data

1 Shipment

Domestic transportation for the MR system, excluding the magnet, will be via an air-ride moving van. The magnet will be shipped on an air-ride flat-bed truck. Export transportation for the MR system overseas will be via air shipment in a pressurized cargo hold. Refer to [Table 9-1](#) for transportation environmental conditions.

See [Table 9-2](#) for the shipping weights and dimensions of the major Signa EXCITE HDe 1.5T system components. Actual shipping may vary, international shipment may require equipment to be crated.

Table 9-1: Transportation Environmental Conditions

System Equipment	Temperature Range °F (°C)	Temperature Change °F/Hr (°C/Hr)	Relative Humidity %	Humidity Change %/Hr	Atmospheric Pressure hPa
Electronics Cabinets & equipment except GOC	-30 to 140 (-34 to 60)	68 (20)	0-90 non-condensing	30	1012 to 525
GOC	-22 to 140 (-30 to 60)	68 (20)	8-90 non-condensing	30	1060 to 500
Magnet	-31 to 122 (-35 to 50)	176 (80)	0-90 non-condensing	30	1012 to 525

The GE LCC Magnet utilizes a Shield/Cryo Cooler System to maintain a reduced helium boil-off. However, the Shield Cooler System is not operational during transportation. Therefore the magnet will require liquid helium replenishment if transportation time exceeds two weeks. Contact GE Service for magnet servicing.

The Magnet is filled with liquid helium at initial shipment but can be allowed to warm up during transportation without damage to the support structure.

Table 9-2: Signa HDe 1.5T Shipping Data

MR Component	Approximate WxDxH		Approximate Weight		Method Of Shipment
	in.	mm	lbs	kg	
1.5T LCC Magnet with cryogenics, partial Quiet Technology Enclosure installed	93 x 144 x 107	2362 x 3658 x 2718	See Note 1		Domestic - Tarped International - crate/pallet
Magnet Accessory Equipment	48 x 48 x 28	1219 x 1219 x 711	400	182	crate
Shield/Cryo Cooler Compressor Cabinet	26 x 28 x 42	660 x 711 x 1067	240	109	skid with box cover
Rear Pedestal Assembly with Rear Split Bridge Assembly, Low Profile Carriage Cover	34 x 58 x 48	864 x 1473 x 1219	310	132	box on pallet
Enclosure Skirts	40 x 24 x 24	1016 x 610 x 610	30	14	box

MR Component	Approximate WxDxH		Approximate Weight		Method Of Shipment
	in.	mm	lbs	kg	
Fixed Site Water Chiller for Gradient Coil Cooling for TypeB	29 x 42 x 33	737 x 1067 x 838	320 dry weight	154 dry weight	crate
Water Chiller (LCS) for Type A	19.7 x 39.3 x 29.5	500 x 1000 x 750	120	55 dry weight	
Water Chiller (MCS) for Type B	27.5 x 39.5 x 31.5	700 x 1000 x 850	220	100 dry weight	
Patient Table	94 x 29 x 38	2377 x 772 x 952	474	215	pallet
Patient Blower Box	24 x 30 x 24	610 x 762 x 610	30	14	box
System Cabinet	52 x 42 x 90.5	1310 x 1060 x 2300	2400	1100	crate
SPT Phantom Set	52 x 42 x 90.5	1310 x 1060 x 2300	2400	1100	crate
Operator Workspace Cabinet	24 x 35 x 31	600 x 900 x 780	243	110	wood pallet with cardboard cover
Operator Workspace LCD Panel	27 x 33 x 27	686 x 838 x 686	125	57	skid
Operator Workspace equipment	32 x 32 x 23	813 x 813 x 584	100	45	box
Operator Workspace Table	45 x 54 x 37	1143 x 1372 x 940	180	82	box
VibroAcoustic Damping Option *	36 x 65 x 12	914 x 1651 x 305	575	261	box on pallet
Outdoor/Indoor Air Cooled MRCC Unit for Type A					
MRCC unit	63.8 x 34.3 x 59.1	1620 x 870 x 1500	750	340	crate
Ship loose items	31.5 x 31.5 x 36	800 x 800 x 920	394	178.5	box
Notes					
* Optional Equipment					
1. Approximate magnet shipping weight of magnet with cryogenics, BRM Gradient & RF coils, Enclosure parts installed on magnet, and lifting beams (i.e. minus packaging material): 11,700 lbs (5320 kg).					
International shipments must add shipping crate/pallet of 2,200 lbs (998 kg).					

2 Storage Requirements

If the system is stored before installation, it must be stored in a warehouse protected from weather. The storage temperature should be between -30 and 140 °F (-34 and 60 °C), the relative humidity between 0 and 90% (non-condensing), and atmospheric pressure 1012 to 525 hPa.

There are two scenarios for storing the 1.5T LCC Magnet. One is to maintain the magnet cold temperature by connecting and operating the Shield/Cryo Cooler System. Periodic replenishment of liquid helium may be required depending on the storage time. The other scenario is to store the magnet without maintaining the cold temperature. The 1.5T LCC Magnet can be moved cold or warm, refer to *Direction 2226318 1.5T & 1.0T LCC Magnet MR/i Delivery and Installation* for magnet moving requirements and details. Contact GE Service for necessary servicing before moving the magnet.

3 Magnet Shipping Considerations

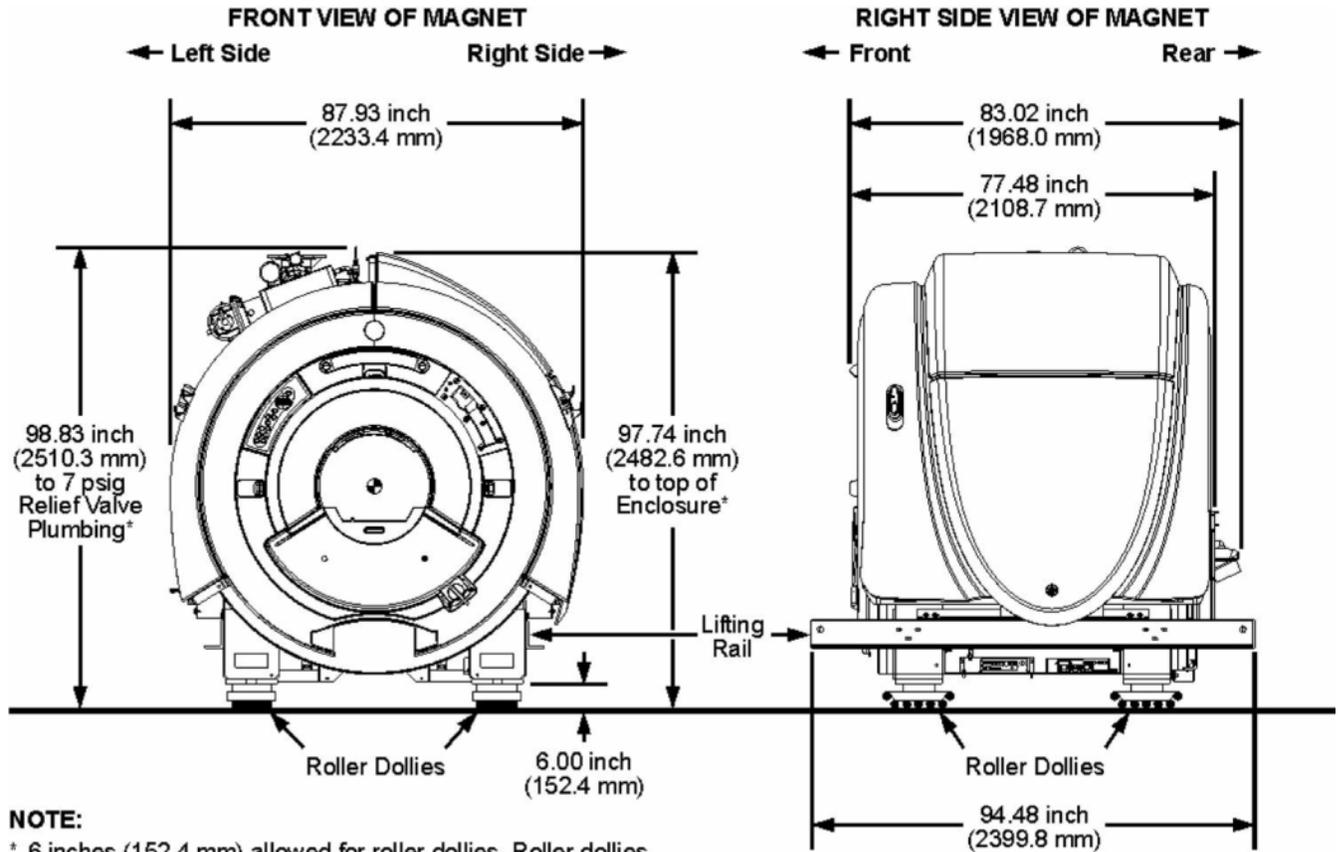
For domestic, the magnet is shipped covered with plastic (no shipping pallet). For export, the magnet is crated for shipment on a special shipping pallet. Refer to table titled Shipping Data in [Shipment](#) for the weight and dimensions of the magnet in its cold ship configuration (i.e. with liquid cryogen in vessel within the cryostat) and with the RF/Gradient Coil inside the magnet bore.

The magnet moving dimensions are shown in [Illustration 9-1](#).

Consideration must be given to the delivery route of the magnet to ensure that the floor can support the magnet and any rigging equipment required to move it. A structural analysis should be performed by a professional structural engineer. The magnet must not be tilted more than 30° in any direction when being moved into position.

The customer is to provide and arrange for riggers to move the magnet from the delivery truck to the final site location. Contact local GE Service for a list of recommended rigger companies. The customer's riggers should have an adequate amount of liability insurance to cover any damage to property or MR system that may occur during delivery of the magnet. The GE Sales Representative or Project Manager-Installations can provide customer riggers with the replacement value of the MR system for insurance purpose.

Illustration 9-1: MAGNET MOVING DIMENSIONS



NOTE:

* 6 inches (152.4 mm) allowed for roller dollies. Roller dollies taller than 6 inches (152.4 mm) increase overall height.

Minimum height for service clearance is 105 inches (2667 mm). This clearance is needed for Main Lead Extensions, Shim Lead and fill line installation.

Source: 51620961DW rev.1.

4 Cold-Shipped Magnet Deliveries



NOTICE

Power and cooling water for the Shield/Cryo Cooler Compressor Cabinet must be available when the Magnet is delivered to minimize cryogen usage. For specifications see Site Environment chapter sections:

- [Chapter 5, Shield/Cryo Cooler Temporary Backup Water Cooling](#) for temporary backup water specifications
- [Chapter 5, Air Cooling](#) for sites using air cooled MRCC unit
- [Chapter 5, Shield/Cryo Cooler Water Cooling For Site Provided Water Cooling](#) for details of Shield/Cryo Cooler Compressor Cabinet requirements

and Power Requirements chapter sections:

- [Chapter 6, System Power Introduction](#)
- [Chapter 6, Critical Power Requirements](#)
- [Chapter 6, Main Disconnect Panel \(MDP\)](#)

Cold-shipped magnets are those magnets which are shipped with liquid helium in the vessel within the cryostat. Thus, when these magnets arrive at site, a cryogen delivery route must be available for moving cryogen dewars to the magnet for periodic replenishment of liquid helium. Also, means must be provided for venting of the cryogenic gases if the GE supplied venting kit is not yet installed and if the RF shielded room vent opening is not completed.

Chapter 10 Site Planning Reminders

1 General Pre-Installation Reminders

The following Reminders define absolute minimum site planning issues that must be completed prior to equipment delivery, installation and calibration. Tables below are organized to identify site planning design requirements, safety requirements, then a list of tasks that must be completed prior to delivery of the magnet or electronics into the MR site. The final group defines tasks that must be completed prior to ramping the magnet to field.

The customer's site planner/architect is expected to use this guide when performing final site completion inspections. The items in the following list assist subsequent inspections. This does not relieve the customer's site planner/architect from meeting any other requirement in this manual.

All work must be in compliance with national and local codes.

2 Site Planning Reminders

2.1 Magnet Room Design and Construction

□ Vibration Study

The vibration study has been completed and vibration sources have been identified and addressed to comply with the specifications. (It is Customer's responsibility to contract a vibration consultant or qualified engineer to implement design modifications to meet the specified limits.) Refer to [Chapter 5, Vibration](#).

□ Magnetic Field

The site design contains the magnetic field and site design complies with the moving metal requirements. Refer to:

- [Chapter 3, Proximity Limits](#)
- For magnetic field containment refer to Magnetic Field Consideration [Chapter 4, Introduction](#), [Chapter 4, Homogeneity Requirements](#), [Chapter 4, Structural Steel Evaluation Of Proposed Sites](#), [Chapter 4, Magnetic Shielding](#), [Chapter 4, Magnetic Field](#), and [Chapter 4, Exclusion Zone](#)
-

□ Structural Steel

The site steel and iron materials comply with the requirements. Refer to

- [Chapter 4, Structural Steel Evaluation Of Proposed Sites](#)
- [Chapter 5, Construction Materials](#)

□ Acoustics

The site has been designed and constructed to contain the MR System acoustic levels to meet local regulations and Customer requirements. Refer to System Acoustic Noise Levels and [Chapter 12, Acoustic Design Guidelines](#).

□ Magnet Room Floor

The Magnet Room floor and recessed Magnet mounting area has been properly design/constructed (location, size, levelness, etc.) relative to the cryogenic vent location, finished floor to center of Magnet opening dimension, Rear Pedestal support, flooring and sub-flooring materials and construction. Refer to [Chapter 8, Determining Cryogenic Vent Location](#) and [Chapter 8, Magnet Room Floors](#).

□ **Environmental Controls**

Environmental controls are installed and functioning to provide the required site environment for all MR System equipment. Refer to

- [Chapter 5, Temperature and Humidity Specifications](#)
- [Chapter 5, Air Cooling](#)
- Water Cooling Requirements
 - [Chapter 5, Gradient Coil Water Cooling](#)
 - [Chapter 5, Gradient Coil Temporary Backup Water Cooling](#)
 - [Chapter 5, Shield/Cryo Cooler Temporary Backup Water Cooling](#)
 - [Chapter 5, Shield/Cryo Cooler Requirements For Site Provided Water Cooling](#)

□ **Air Conditioning**

Air conditioning required 24 hour/day, 7 days/week before magnet delivery, when indoor equipment chiller is used. Also if system installing with out equipment room, appropriately air-conditioning required for system cabinet install room. Refer to [Chapter 5, Temperature and Humidity Specifications](#) and [Chapter 5, Air Cooling](#).

□ **Power Quality**

The site power plan meets the power quality requirements. Refer to [Chapter 6, System Power Introduction](#) and [Chapter 6, Critical Power Requirements](#).

□ **Water Cooling**

Chiller is installed and operational 24 hour/day, 7 days/week for the Shield/Cryo Cooler cabinet. Refer to [Chapter 5, Shield/Cryo Cooler Requirements For Site Provided Water Cooling](#).

□ **Magnet Room Anchors**

All Magnet Room anchors have been installed, with ground impedance test performed to meet requirements. Installed and test results recorded by RF Shield Room Vendor and information forwarded to the customer to be maintained with the site documentation. Refer to [Chapter 8, Electrical Isolation](#).

□ **Magnet Room Anchors Torque/Pull Test**

All Magnet Room anchors have had a pull tests performed on them, and meet requirements and the installation torque value as defined. The RF Shield Vendor has recorded test results. Customer needs to maintain a copy of the pull tests results with the site documentation. Refer to [Chapter 8, Clamping Force \(Tension\) and Pull Test](#)

- **RF Shield room special construction requirement for HDe**

[Chapter 8, RF Shield Consideration for System Cabinet and Penetration Panel](#)

- **HDe single cabinet anchor special construction requirement**

[Chapter 3, System Cabinet Special Consideration](#)

- **RF Shield Tunnel (Mesh Shield) mounting screw preparation requirement**

RF Shield room cutoff size has been properly design/constructed (location, size, etc.). RF Shield tunnel mounting screw is needed to supply by RF shield Vender. So, please make sure it was available before finished RF shield room construction. Refer to [Chapter 3, System Cabinet Special Consideration](#) and [Chapter 8, RF Shield consideration for System Cabinet and Penetration Panel](#). RF Shield tunnel (Mesh Shield) mounting screws are needed to be supplied by RF shield Vender before system mechanical installation.

- **Multiple MR System Site** □ **Not Applicable**

The site design complies with the requirements for sites with more than one magnet in the magnetic field area or the Equipment Room is shared by more than one MR system of the same field strength. Refer to [Chapter 3, Two Magnet Site Layout](#) and [Chapter 3, Equipment Room Shared By Multiple MR Systems](#).

- **Type C System Configuration (Europe Only)**

For Type C System Configuration, refer to [Chapter 3, General Information of Type C Configuration](#)

2.2 Required Before Magnet Delivery to Customer

NOTE: The customer's site planner/architect is expected to use this guide when performing final site completion inspections. The items in the following list assist subsequent inspections. This does not relieve the customer's site planner/architect from meeting any other requirement in this manual.

The following items must be completed prior to system delivery. A site inspection by GE Service Representative must be completed prior to system delivery to ensure site readiness.

- **MDP installed & primary VAC Power available**

The Main Disconnect Panel (MDP) has been installed, electrician wiring complete, and the MDP is operational with power available. Refer to [Chapter 6, System Power Introduction](#) and [Chapter 6, Critical Power Requirements](#).

- **Room Ventilation & Air Conditioning**

All of the required Magnet Room ventilation items have been installed and tested to make sure sufficient ventilation is available. The exhaust fan and fan controls are installed and functional. The customer needs to maintain a copy of the Exhaust Fan System test reports with the site documentation. Refer to [Chapter 5, Room Ventilation](#)

- **Broadband Network Connection & Telephone**

Functioning Broadband (network) connections and telephone are available at the site for the duration of the installation and system operation. Broadband is needed for Magnet Monitor and MR System computer access. Telephone is needed to dial out in case of an emergency. Refer to [Chapter 3, System Monitoring and Support Connectivity](#).

- **Cryogenic Vent**

The cryogenic vent has been installed complete and inspected from the Magnet Room RF to the final exit outside of the building. The customer needs to maintain a copy of the Vent Inspection Report with the site documentation. Refer to Cryogenic Venting Introduction, Requirements For Inside Magnet Room, and Requirements For Outside Magnet Room.

2.3 Required Before Electronics System Delivery Customer

NOTE: The customer's site planner/architect is expected to use this guide when performing final site completion inspections. The items in the following list assist subsequent inspections. This does not relieve the customer's site planner/architect from meeting any other requirement in this manual.

- **RF Shielding**

The Magnet Room has been tested to ensure that the RF shielding meets the attenuation and electrical isolation requirements after magnet delivery. Refer to [Chapter 8, RF Shield Room Requirement](#). Customer needs to maintain a copy of the RF shielded room vendor test reports with the site documentation.

- **Lighting**

The Magnet Room lighting installed and designed to comply with the requirements so as to not to generate RF noise, which would be detrimental to the ability of the MR System to produce images of good quality. Refer to [Chapter 5, Lighting](#).

- **Dust-Free Environment**

All of the areas in the MR System Equipment Room and Control Room are complete, so a dust-free environment is available for the installation of the equipment. Refer to [Chapter 5, Pollution](#).

- **Broadband**

Broadband is installed and operational. Refer to [Chapter 3, System Monitoring and Support Connectivity](#).

3 Typical MR Installation Project Schedule

The MR Project schedule shown in [Illustration 10-1](#) depicts a typical Signa HDe installation. The purpose of this project schedule is to provide a guide for your MR project in regards to tasks which need to be completed, duration of each task and who is primarily responsible for completion of the task. This project schedule starts at MDP and MRCC/or magnet delivery which occurs when your site construction is completed, except for magnet room opening. Your GE Project Manager-Installations can provide more detailed information if needed.

Illustration 10-1: Typical Signa HDe Installation Project Schedule

Typical MR Installation Schedule	Duration	Responsibility	Week 1					Week 2					Week 3				
			M	T	W	T	F	M	T	W	T	F	M	T	W	T	F
Magnet delivered	.5 day	GE	█														
Magnet mechanical / electrical	.5 day	GE	█														
Magnet room closure	3 days	Contractor		█	█	█											
Shielding is completed and tested		Contractor		█	█	█											
Complete magnet room opening		Contractor		█	█	█											
Flooring completed		Contractor		█	█	█											
MR system delivered	.5 day	GE															█
Mechanical Installation of system	2.5 days	GE						█	█	█							
Calibration of system	4 days	GE									█	█	█	█			
Option installation	depends on # of option	GE/Vendor															█
MR system available to customer																	█

Chapter 11 Tools and Test Equipment

1 Moving Metal Measurement Equipment

Table 11-1: Moving Metal Measurement Equipment

Item	GE Part Number	Description
1	2175019 or equivalent	Multiwave II Kit with Barrington 3 axis probe

2 Rigger/Customer Supplied Equipment

Table 11-2: Rigger/Customer Supplied Equipment

Supplied By	Item	Description
Rigger	1	Refer to <i>Direction 2226318 1.5T & 1.0T LCC Magnet Signa MR/i Delivery and Installation Manual</i> for equipment and requirements.
Customer	2	Equipment for off loading electronics and other miscellaneous components. (e.g. fork lift, hand trucks, straps, etc.)
	3	Panel lifters for computer flooring: Smooth floor Indicon Industries PL2DC Standard carpeted floor Indicon Industries PL30P Level loop carpet floor Indicon Industries SCLV1.
Customer/Contractor	4	Resistance meter: <ul style="list-style-type: none"> • Megger Insulation Tester - preferred test unit • Analog d'Arsonval Meter (meter must have test source >9 VDC per specification in <i>Appendix Chapter 12, RF Shielded Enclosure Test Guideline titled Enclosure Power Reference Isolation</i>)

3 Cryogenic Equipment

Table 11-3: Cryogenic Equipment

Item	GE Part Number	Description
1	5111049	Gaswatch personal Oxygen monitor
2	46-306734G1	Low Pressure Regulator Kit (Non-magnetic gas cylinder regulator / hose assembly consisting of regulator, hose, and case) (See Note 2)
3	---	Liquid helium in non-magnetic dewars is needed for refilling the magnet (See Note 2). Refer to appropriate magnet manual for helium volume.
4	46-306717G1	Non-magnetic gaseous helium cylinder cart (See Note 2)
5	46-294705G1	Universal Fill Line Kit (See Note 2)
6	46-294511P1	250 Liter Dewar Stinger (See Note 2)
7	46-294511P2	500 Liter Dewar Stinger (See Note 2)
8	46-294512P1 (12 ft)	Transfer Line (See Note 2)
	46-294512P2 (8 ft)	
9	46-282336P2	Dewar stinger assembly (High Efficiency) (See Note 2)
10	46-306812G1	Dewar tube "Thumper" tool (See Note 2)
11	2253802	Burst Disk and Gasket Assembly for LCC Magnet Helium Vessel (See Note 1)
12	46-271136G1	Dewar Adapting Kit including O-ring Kit for Dewar Adapting kit (46-271135P9) (See Note 2)
13	46-294804G1	Non-magnetic Aeroquip wrench Set (See Note 2) includes the following: <ul style="list-style-type: none"> • 46-294800G1 case for bronze wrench kit • 46-294805P1 bronze 1 5/8 in. open end wrench • 46-294805P2 bronze 1 3/8 in. open end wrench • 46-294805P3 bronze 1 3/16 in. open end wrench • 46-294805P4 bronze 1 1/8 in. open end wrench • 46-294805P5 bronze 1 in. open end wrench
14	46-281088G3	Shield Cooler Installation / Maintenance Kit (See Note 2)
15	46-265273G1	Liquid Helium Level Meter Kit (See Note 2)
16	2362622	Remote Helium Meter
17	46-306781G1	Helium Mechanical Gas Flowmeter (See Note 2)
18	46-301477G1	Helium Mechanical Gas Flowmeter (See Note 2)
19	46-252210P1	3 Inch Valve Operator (vacuum break tool) (See Note 1)
20	46-294872G2	SAV-CON / Instrumentation Lead Service Kit (See Note 2)
21	46-318784G2	Shield Cooler Test Kit (See Note 2)
22	46-318696G1	Water Tee for Shield Cooler Water Samples access (See Note 2)
23	46-294052G1	Water Flow Meter Kit (for checking flow of water to Shield Cooler Compressor) (See Note 2)
24	2171219	RUO Temperature Monitor for LCC 1.5T , 1.0T, & 3.0T Magnet (See Note 2)
25	---	Torch for de-icing
26	---	Fuel for torch
27	46-252805P2 (10 ft)	Nitrogen Transfill line (only needed if magnet is warmer than nitrogen temperature)
	46-252805P3 (15 ft)	
28	46-260201P1	N2 Precool Syphon (only needed if magnet is warmer than nitrogen temperature)
29	5160887	Standard mid arm cryo gloves medium size

Item	GE Part Number	Description
30	5160896	Standard mid arm cryo gloves large size
31	5160897	Standard mid arm cryo gloves X-L size
32	TBD	safety galses
33	TBD	face shield
Notes		
1. Supplied as part of Signa.		
2. Supplied by GE until turnover of system to customer, then available as part of a GE Cryogen and/or Service Contract.		

4 Installation Equipment

Table 11-4: Installation Equipment

Item	GE Part Number	Description
1	---	Ramp for removing cabinets from pallets for International shipments (See Note 1)
2	---	Wrecking bar
3	---	Claw hammer, 3/4 lb
4	46-271138G1	Restricted Access Control Kit. Contains two plastic warning signs for posting at site during installation and service activity.
5	46-294060G4	Mapping Fixture for field plotting equipment for Cx/LCC magnet Typically not needed to map Cx/LCC Magnet depending on proximity of steel at site. Refer to information under Magnet Room Floors Magnetic Properties heading in Chapter 5, Construction Materials
6	2163971	Field Mapping Fixture Upgrade Kit to make kit compatible with Cx/LCC Magnets Used to upgrade 46-294060G3 to 46-294060G4
7	---	Magnet Log Book
8	---	Installation log book
9	---	4 foot or equivalent carpenter level
10	2319156	Aluminum platform ladder, 47.5 inches (1206.5mm) (See Note 1)
11	2134776	Gradient Cable Crimper/Stripper Kit (Note 2) consisting of: <ul style="list-style-type: none"> • 2134586 Cable stripping tool • 2134586-2 Stripping tool replacement blade • 2134587 Cable slicer • 46-282853P1 Ratcheting crimper • 2135839 1/2 inch terminals • 2135839-2 3/8 inch terminals
12	46-260776G3	Magnet Service Tool 750 Amp Power Supply Cabinet dimensions W x D x H is 24.5 in. x 31.5 in. x 35.75 in. (622 mm x 801 mm x 908 mm) and weight of 375 lbs (170 kg).
13	46-260776G4	Magnet Service Tool 1000 Amp Power Supply Cabinet dimensions W x D x H is 24.5 in. x 31.5 in. x 35.75 in. (622 mm x 801 mm x 908 mm) and weight of 375 lbs (170 kg).
14	46-260777G3	Shim Service Tool Power Supply Cabinet dimensions W x D x H is 24.5 in. x 31.5 in. x 35.75 in. (622 mm x 801 mm x 908 mm) and weight of 290 lbs (132 kg).
16	46-306763G1	Subminiature-D Connector Removal/Re-termination Repair Kit for Robinson-Nugent Sub-D connectors
17	46-251865G4	Field Plotting Kit - Metro Lab Teslameter
18	46-260703G5	Magnet Ramping Equipment Kit
19	2135435	750 Amp Ramp Cart / Cable Kit
20	46-318833G1	Ramp Cable Holder
21	46-294998G1	Ramping Supply and Equipment kit includes the following: <ul style="list-style-type: none"> • 46-260703G3 Magnet Ramping Equipment Kit (see Item 15) • 46-260776G3 Magnet Service Tool Power Supply Cabinet (see Item 10)

Item	GE Part Number	Description
22	46-320273G3 or G4	Non-Magnetic Tool Kit - Universal (See Note 2) Both metric and inch Non-Magnetic Tool Kits needed. May substitute both of the following kits: <ul style="list-style-type: none"> • 46-320273G1 Non-Magnetic Tool Kit - Metric • 46-320273G2 Non-Magnetic Tool Kit - Inch
23	M1060SR	Magnet Low Ceiling Height (2.5 Meter) Siting Option NOTE: This option reduces the minimum required ceiling height for the Magnet Room to 2.5 meters from 2.67 meters. Check with GE Installation Specialist to determine if this is a required option.
Notes 1. Supplied as part of Signa. 2. Supplied by GE until turnover of system to customer, then available as part of a GE Cryogen and/or Service Contract.		

5 Test Equipment

Table 11-5: Test Equipment

Item	GE Part Number	Description
1	2284754-2	Textronic TDS3012B digital scope 100 MHz Bandwidth
2	2284754	Textronic TDS3012 digital scope 100 MHz Bandwidth
3	2284763	Fluke FLK196M scopemeter for medical applications
4	46-194427P226	Dual trace oscilloscope, 100 MHz bandwidth, 2 channel, digital storage, Textronic 2232 (End of Product Life)
5	46-194427P222	Dual trace oscilloscope, 350 MHz bandwidth, 4 channel, Textronic 2465 (End of Product Life)
6	46-194427P284	Battery operated digital multi-meter, Fluke 87, 4.5 digits with frequency counter and capacitance
7	46-208572P9	Clamp-on Ammeter, 1-200A, AC/DC
8	46-317724G2	RF Power Measurement Kit with Attenuator/ load, 200 Watt, 30 dB attenuator 46-317724P14
9	2218826	RPM 1650 Power Analyzer Kit
10	46-328143G3	Dranetz 626 analyzer kit with 1 and 3 phase modules
11	Catalog E6320DA or 46-194427P144	Densitometer
12	46-306801G1	Bell Gauss Meter Kit
13	2293050	Portable Gauss Meter with probe and case
14	46-194427P248	Microguard or ECOS leakage tester
15	46-306797G1	Fogg (ECG) Simulator and Memory Module
16	46-320433P1	Infrared Scanner 0 - 100°C
17	46-317830G1	Fiber Optic Light Meter Kit
18	46-294047G1	Shield Cooler Vacuum Pump Kit
19	46-251867G1	Main Vacuum Pump Down Kit
20	46-1944278P448	AEMC Clamp-On Ground Rod Impedance Meter

6 Calibration Tools and Fixtures

Table 11-6: Calibration Tools and Fixtures

Item	GE Part Number	Description
1	46-307500G1	Longitudinal Drive Force Gauge
2	2133388-6	System Performance Test (SPT) Phantom Set for Systems with Cx/LCC systems (See Note 1) consisting of the following: <ul style="list-style-type: none"> • 2125247-10 Nesting Plate • 2125245 Large Volume Shim Phantom Assembly which includes sphere, small half, and large half • 2125244 Short Loader Assembly • 2131027-2 Daily Quality Assurance (DQA) Phantom • 2134213 SPT 1.5T 6 Coil Grafidy III KitShipping/Storage Cart (Not used for Mobile Systems) • 2170481 EPI Foam Positioner • 2141454 Quick ShimPositioner
3	46-287900G3	Head TLT Sphere (46-265826G6), one 100 mm Nickel Chloride sphere (46-317586G1), and Loader (46-287899G1) See Note 1
4	46-255816G1	RF Test Cables Kit
5	46-265434G1	Magnet Rundown Unit Test Box
6	5135527	1.5T 6 Coil Grafidy III Kit
7	46-328021G1	Enmet Oxygen Monitor Calibration consisting of the following: <ul style="list-style-type: none"> • 1800 PSI cylinder of 20.9% Oxygen in Nitrogen • 1800 PSI cylinder of 17% Oxygen in Nitrogen • Regulators with calibration adapter For use with portable or permanent Oxygen Monitor.
8	2106236	Portable Oxygen Monitor (Connecticut Analytical)
9	2107184	Permanent Oxygen Monitor (Enmet)
10	46-301549G1	TPS RF Test Cable/Adapter Kit
11	46-301927G1	TPS RF Service Interface Kit (See Note 2)
12	46-306712G1	Torque driver kit
13	46-306864G1	Magnet Helium Resistance Box Kit
14	2101360	Power Supply Calibration Kit
15	46-265826G3	Head Signal-to-noise (SNR) sphere (See Note 3)
16	Head Signal-to-noise (SNR) sphere (See Note 3)	Body Signal-to-noise (SNR) sphere (See Note 3)
17	46-265635G2	Body T2 sphere (See Note 3)
18	2371477	100 mm Silicon Oil sphere (2360034) and Universal Phantom Holder (46-328383P1) (See Note 1)
<p>Notes</p> <ol style="list-style-type: none"> 1. Supplied as part of Signa. 2. Supplied by GE until turnover of system to customer, then available as part of a GE Service Contract. 3. Customer may purchase these items. 		

7 Tool Kit

Table 11-7: Tool Kit

Item	GE Part Number	Description
1	---	Extension cords, with ground conductor
2	---	Power strip, grounded type, with minimum of five outlets
3	---	Soldering iron, pencil type with solder
4	---	Solder sucker
5	---	Assortment of Brady Quick labels
6	---	Micro clip leads
7	---	14 pin and 16 pin DIP clips
8	46-258218P3	Vinyl electrical tape
9	46-258218P4	Copper tape, 3 in. wide
10	46-258218P5	Copper tape, 2 in. wide
11	46-258218P6	Copper tape, 1 in. wide
12	---	Alcohol cleaning solution
13	---	Plastic or aluminum flashlight
14	---	Plastic or aluminum pen light
15	AMP No. 458994-1	Pin extractor, Universal Mate'n'Lock
16	AMP No. 305183-R	Pin extractor, M-series
17	46-237072P1	Pin extractor, Sub-D
18	46-307307G1	Crimping tool for coax cable and BNC connectors Inserts for <ul style="list-style-type: none"> • RG8, 9, 11, 214 46-255841P103 • RG58, 223 46-255841P100 • RG59 46-255841P101 • RG174 46-255841P102 • Die Removal Tool 46-255841P201
19	---	Assorted crimp tools.
20	---	Non-magnetic level
21	---	Non-magnetic tape rule, 12 ft
22	---	Assorted drill bits
23	---	Inspection mirror
24	---	Tap set, standard, and tap handle, T-type
25	---	rule, standard and metric markings
26	---	Alignment tool (tweaker)
27	---	Hex/alignment tool
28	---	Hemostat, 5 in., curved
29	---	Wrist grounding strap
30	Xcelite 110CG	Diagonal Cutting Pliers, 4-1/2 in.
31	---	Screw Starter, aluminum or plastic shaft
32	---	Hobby and utility knives
33	---	Spring scales, 0-10 lbs and 0-50 lbs
34	46-313413P1	Extractor for 20 - 100 pin PLCC Chips

Item	GE Part Number	Description
35	5112581	Large set Non-Magnetic Titanium Tool kit with aluminum case (generally used for installations)
36	5113258	Small Non-Magnetic Titanium Tool kit with soft case (generally used for routine maintenance)

Chapter 12 Appendices

1 Glossary

BB

Abbreviation for Broadband

Cryogen

A substance for producing low temperatures. Liquid helium is the cryogen used to cool the magnet to approximately 4 Kelvin (-269°C or -452°F).

Cryostat

An apparatus maintaining a very low constant temperature. The cryostat consists of one concentric, cylindrical container housed in an outer vacuum tight vessel. The magnet and shim coils are mounted in the inner container. The container is filled with liquid helium. The shields surrounding the inner container are kept cold by a refrigeration device.

Dewar

A container with an evacuated space between two highly reflective walls used to keep low temperature substances at near-constant temperatures. Liquid helium is usually stored and shipped in dewars.

Exclusion Zone

Area where the magnetic flux density is greater than five gauss. Personnel with cardiac pacemakers, neurostimulators and other biostimulation devices must NOT enter this zone. Signs are posted outside the five gauss line alerting personnel of this requirement. Since the magnetic field is three-dimensional, signs are also posted on floors above and below the Magnet Room in which the five gauss line exists.

Ferrous Material

Any substance containing iron which is strongly attracted by a magnetic field.

Gauss (G)

A unit of magnetic flux density. The earth's magnetic field strength is approximately one half gauss to one gauss depending on location. The internationally accepted unit is the tesla (1 Tesla = 10,000G and 1 milli Tesla = 10G).

Gradient

The amount and direction of the rate of change in space of the magnetic field strength. In the magnetic resonance system, gradient amplifiers and coils are used to vary the magnetic field strength in the x, y, and z planes.

Homogeneity

Uniformity. The homogeneity of the static magnetic field is an important quality of the magnet.

Isocenter

Center of the imaging volume ideally located at the magnet center.

Isogauss Line

An imaginary line or a line on a field plot connecting identical magnetic field strength points.

Magnetic Field (B)

A condition in a region of space established by the presence of a magnet and characterized by the presence of a detectable magnetic force at every point in the region. A magnetic field exists in the space around a magnet (or current carrying conductor) and can produce a magnetizing force on a body within it.

Magnetic Resonance (MR)

The absorption or emission of electromagnetic energy by nuclei in a static magnetic field, after excitation by a suitable radio frequency field.

Magnetic Shielding

Using material (e.g. steel) to redistribute a magnetic field , usually to reduce fringe fields.

NB

Abbreviation for Narrow Band

Quench

Condition when a superconducting magnet becomes resistive thus rapidly boiling off liquid helium. The magnetic field reduces rapidly after a quench.

Radio Frequency (RF)

Frequency intermediate between audio frequency and infrared frequencies. Used in magnetic resonance systems to excite nuclei to resonance. Typical frequency range for magnetic resonance systems is 5-130 Mhz.

Radio Frequency Shielding

Using material (e.g. copper, aluminium, or steel) to reduce interference from external radio frequencies. A radio frequency shielded room usually encloses the entire magnet room.

Resonance

A large amplitude vibration caused by a relative small periodic stimulus of the same or nearly the same period as the natural vibration period of the system. In magnetic resonance imaging, the

radio frequency pulses are the periodic stimuli which are at the same vibration period as the hydrogen nuclei being imaged.

Security Zone

Area within the Magnet Room where the magnet is located. Signs are posted outside the Magnet Room warning personnel of the high magnetic field existing in the Magnet Room and the possibility of ferrous objects becoming dangerous projectiles within this zone.

Shield Cooler Coldhead

An external refrigeration device which maintains the shields inside the cryostat at a constant temperature.

Shim Coils

Shim coils are used to provide auxiliary magnetic fields in order to compensate for inhomogeneities in the main magnetic field due to imperfections in the manufacturing of the magnet or affects of steel in the surrounding environment.

Shimming

Correction of inhomogeneity of the main magnetic field due to imperfections in the magnet or to the presence of external ferromagnetic objects.

Superconducting Magnet

A magnet whose magnetic field originates from current flowing through a superconductor. Such a magnet is enclosed in a cryostat.

Superconductor

A substance whose electrical resistance essentially disappears at temperatures near zero Kelvin. A commonly used superconductor in magnetic resonance imaging system magnets is niobium-titanium embedded in a copper matrix.

Tesla

The internationally accepted unit of magnetic flux density. One tesla is equal to 10,000 gauss. One milli Tesla is equal to 10 gauss.

2 MR Site Vibration Test Guidelines

2.1 Test Measurements

- Vibration measurements are in the range of 10^{-6} g. Test equipment must have the required sensitivity to these levels.
- Instrumentation is recommended to have a low tolerance to temperature effects as many times the low frequency thermal drift may influence the measurements.
- It is highly recommended all measured data is real time data acquisition. Recording of vibration data will not allow for a proper site survey, specifically when studying transient vibration and when searching for specific vibration sources.
- All analyses are to be narrowband Fast Fourier Transforms (FFT's) over the frequency bands listed in [Table 12-1](#).
- Time histories of the vibration must be recorded as acceleration levels vs. time. The resolution of the time history must be adjusted to clearly capture the transient event. The analyzer set-up will be site dependent and, in special cases, vibration response dependent. It is the responsibility of the vibration consultant to study the transient environment, capture data to confirm transient activity exceeds the trigger level, then expand the time history data to exhibit the structural response.

Table 12-1: Frequency Bands For FFT'S

Frequency Band	Frequency Resolution
0.2 to 50 Hz	$\Delta f = 0.125$ Hz

2.2 Equipment (Spectral Analyzer) Set-Up

- Frequency average a minimum of 20 linear averages Do not use peak hold or 1/3 octave analysis.
- Average and store a minimum of 10 plots to support the site vibrations consistency.
- Hanning window must be applied to the entire spectra

Spectrum analyzers capable of these measurements are readily available for purchase or rental. Models such as the HP 3560A, Nicolet Phaszer, B&K Pulse, and HP 35670 are all capable of making the site vibration measurements. Accelerometers must have the capability to measure from 0.2 Hz beyond 50 Hz. Time histories can be recorded using any of the analyzers listed above. Please note that the equipment mentioned are for example only. It is the responsibility of the Engineering test firm to provide equipment that will allow measurements compliant with this guideline.

2.3 Data Collection

2.3.1 Ambient Baseline Condition

All of the measurements defined in [Section 2.1](#) and [Section 2.2](#) must be made in a 'quiet' environment. That is, in areas where excessive traffic, subway trains, etc. exists, a vibration measurement must also be made during periods without traffic or during periods of light traffic. Measurements must define the lowest levels of vibration possible at the site.

The source of any steady state vibration whose levels exceed the Magnet specifications in [Chapter 5, Vibration](#) must be identified as to the source of the vibration disturbance. A second measurement should be made with all of the identified contributors powered down if possible. In situations where

it is not possible to power down equipment, vibration data must be collected to identify specific source of the vibration concern. The majority of steady state vibration problems can be negated by isolating the vibration source.

2.3.2 Normal Condition

All of the vibration measurements listed above must be repeated during periods of 'normal' environmental conditions including the FFT's and time histories. The transient measurements must be provided to define the dynamic disturbances the MR system might be exposed to. Transient analysis is required for a true assessment of the site.

Special attention must be paid to the site assessment during the entire analysis. Since transient vibration is not easily addressed once the MR suite is fully constructed, the test consultant must fully understand the needs for this analysis. The source of any transient must be identified and supported with vibration plots. If the source of any transient is not able to be located, it is recommended that the customer should have an alternate location identified and vibration studied.

Transient vibration can be difficult to assess if the details of the transient vibration is not understood. The **0.0005g, zero to peak trigger level** is a starting point to begin understanding the vibration stability. The transient vibration peak amplitude, structural (time variant) response, decay rate and an estimate of the number of events per unit time would constitute a complete transient analysis. All transient failures must be supported by time history plots. The plots must clearly show the structural response, the frequency of the signature and the decay rate. From this data, GE can help determine compliance to the vibration guidelines.

Test consultant must prove design recommendations for all sites/building structures which are found to exceed the LCC Magnet specifications in [Chapter 5, Vibration](#).

2.4 Presentation/Interpretation Of Results

The recommended format for site vibration data collection, presentation, and analysis is illustrated in the examples shown in [Illustration 12-1](#), [Illustration 12-2](#), [Illustration 12-3](#), and [Illustration 12-4](#). Presentation of the data in any other format (linear units only) may result in an incorrect interpretation and diagnosis of the site. Additional data collection or presentation methods is at the option of the vibration testing service.

All plots must be properly annotated with:

- Instrumentation setup including number of averages, frequency resolution, etc.
- Test location
- Test conditions
 - Steady State
 - Transient
 - Heal drop
 - Normal Environment
 - Typical traffic

NOTE: Please note that other conditions not listed could also be conditions necessary to demonstrate understanding of potential sources of vibration.

It is the responsibility of the customer's vibration testing service to interpret the results and determine if that site meets GE's specifications. [Illustration 12-1](#) and [Illustration 12-2](#) are examples provided to assist a test consultant in the use of GE Steady State specifications (vibration specifications above ambient baseline). If the vibration levels are too high, additional data acquisition may be necessary to:

- determine the source of the vibration
- propose a solution to the problem
- find an alternate site location.

[Illustration 12-1](#), [Illustration 12-2](#), [Illustration 12-3](#), and [Illustration 12-4](#) are examples provided to assist a test consultant in the use of GE Transient specifications. The 500 micro-g, zero to peak trigger level identifies data collection to begin assessment of the site vibration analysis. The response of the transient must be assessed relative to the LCC300 Magnet Steady State vibration specifications in [Chapter 5, Vibration](#).

Any questions regarding test equipment requirements, test parameters, or general questions should be discussed with your GE Project Manager-Installations.

Illustration 12-1: Example Site Environmental Vibration

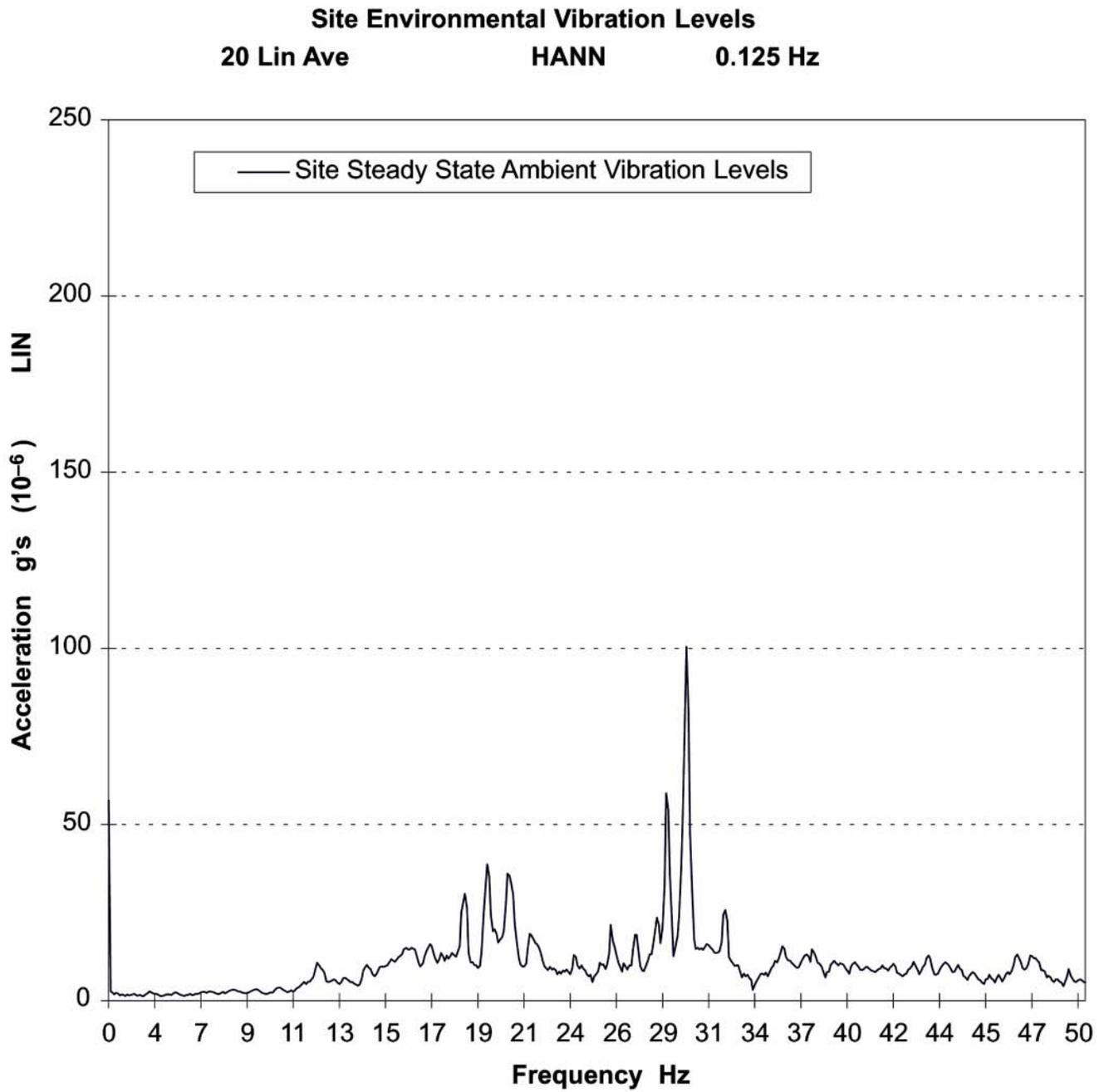


Illustration 12-2: Example Site Environmental Vibration

EXAMPLE: Site Environmental Vibration vs. GE Spec. for 1.5T Magnet
20 Lin Ave Hann 0.125Hz

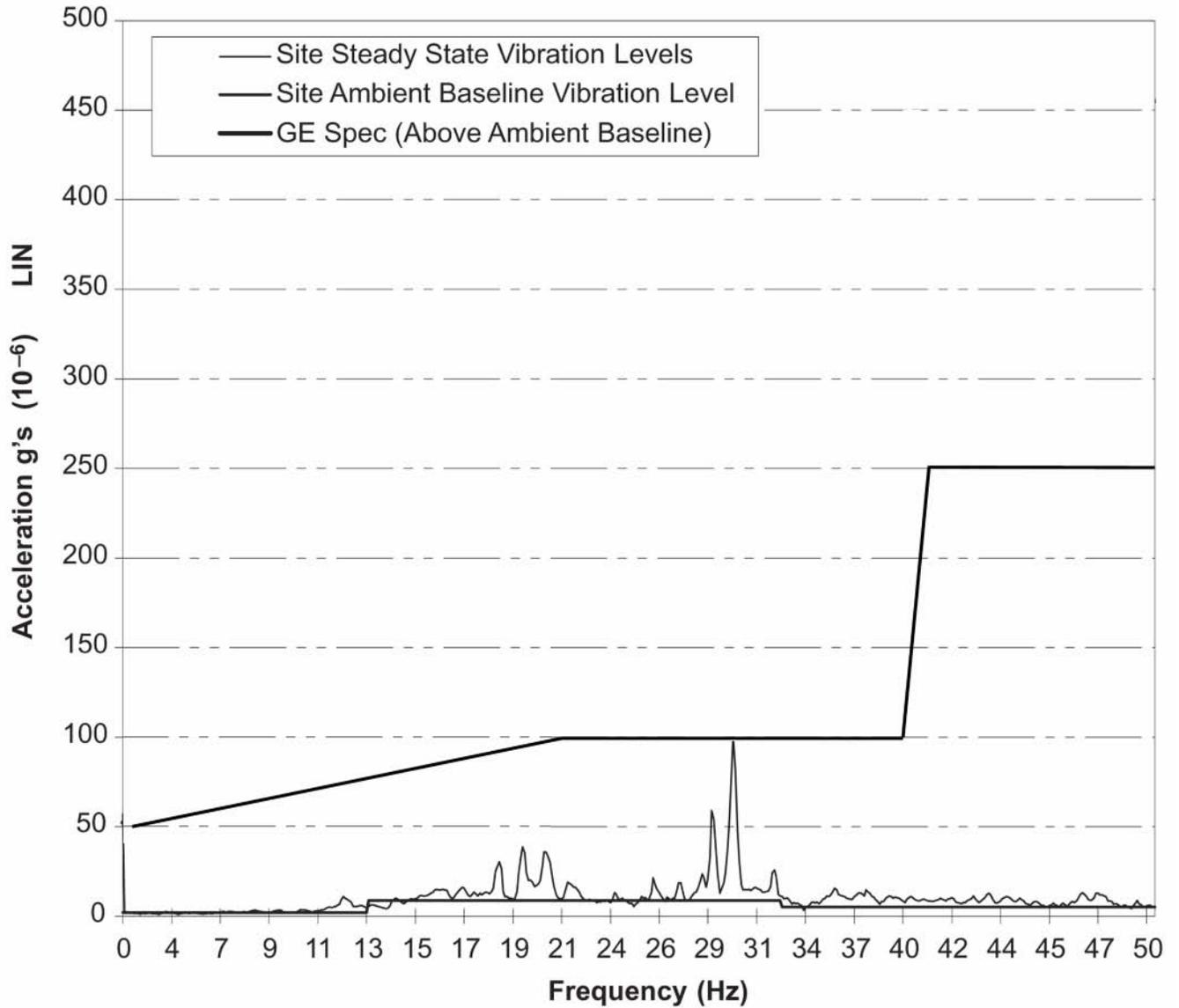


Illustration 12-3: Acceleration Time History

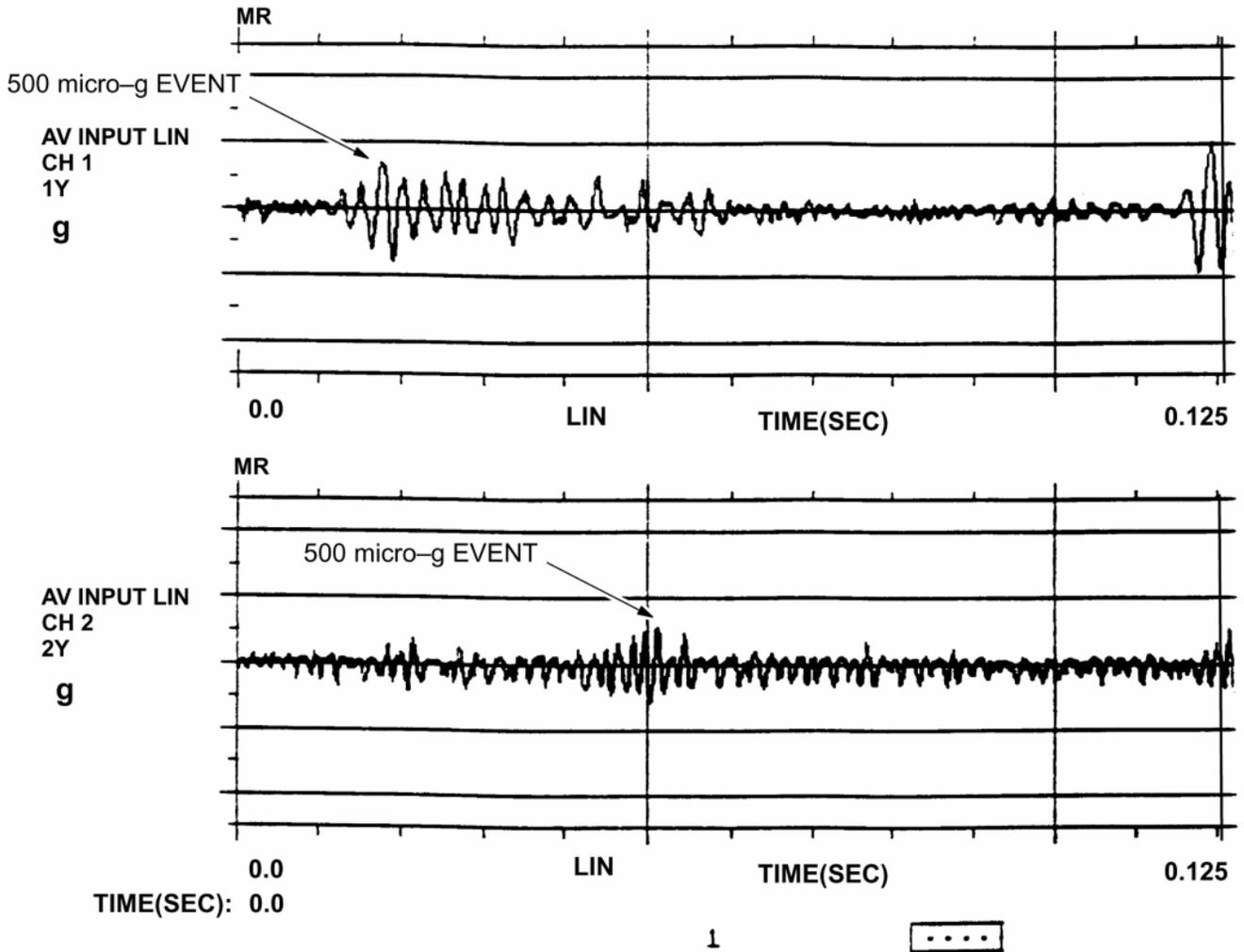
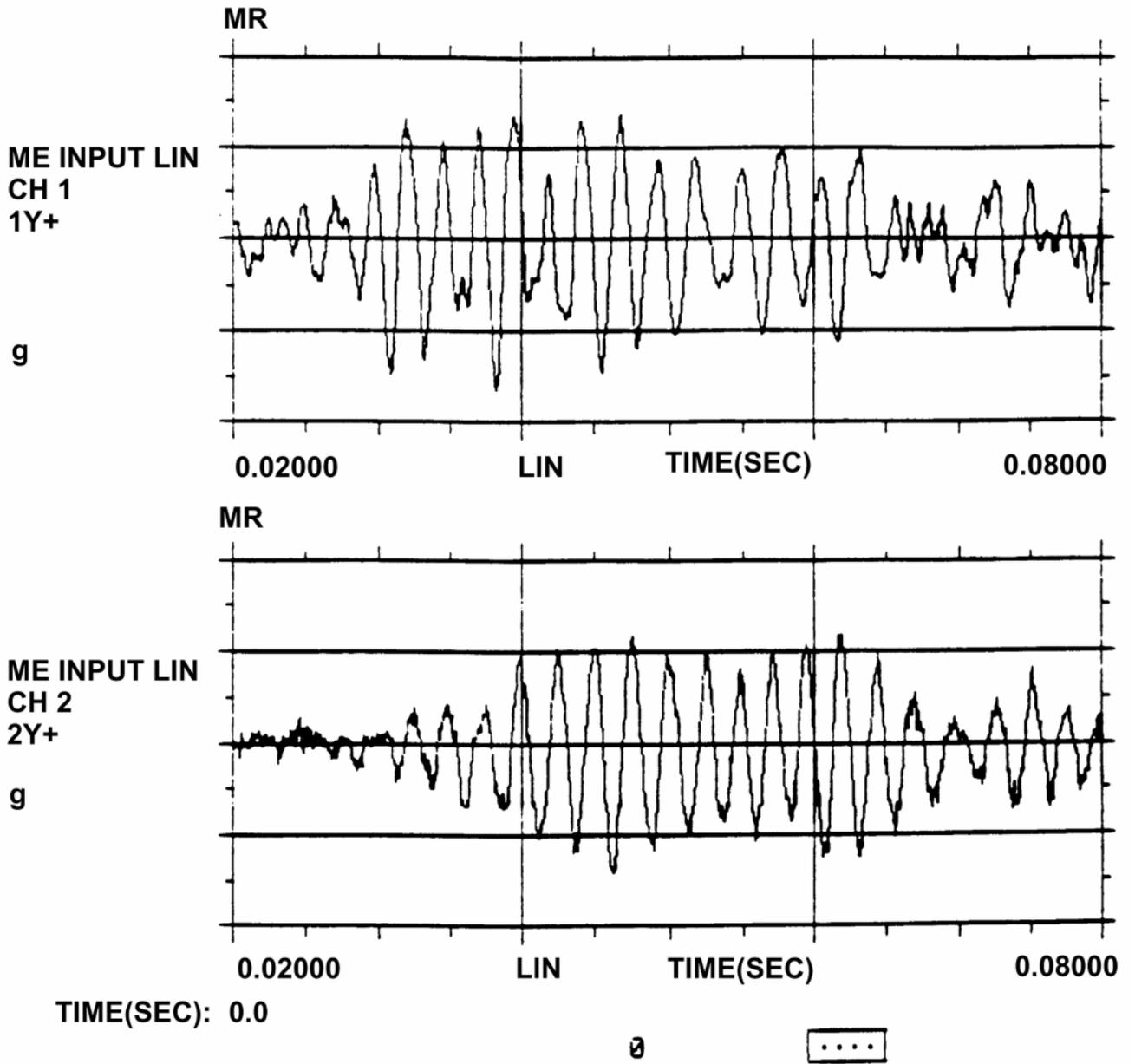


Illustration 12-4: Acceleration Time History (Zoomed In On Transient Event)



3 RF Shielded Enclosure Test Guidelines

3.1 Introduction

This document describes the procedure and methodology of performing an RF shielding effectiveness verification testing on enclosures that will house GE Healthcare Magnetic Resonance Imaging (MRI) equipment. MRI equipment is sensitive to RF energy from sources outside of the shielded enclosure. To ensure proper operation of the MRI equipment, the shielded enclosure must attenuate local RF signals to levels that do not cause interference.

NOTE: RF Shielding Performance is based on plane-wave measurements. *H* and *F* field tests are not required, but are allowed as needed for diagnostic purposes.

3.1.1 Purpose of Test Plan

The purpose of this test plan is to describe a series of RF shielding effectiveness tests to demonstrate compliance of an MRI shielded enclosure to the requirements of GE Healthcare.

The test procedure described in this guideline is a modification of MIL-STD-285 and IEEE Std 299-1991. This procedure provides a thorough evaluation of the shield integrity at the upper end of the frequency range of interest showing any RF leakage that may cause imaging problems. These testing guidelines ensure that the electromagnetic environment inside of the enclosure will meet the requirements of GE Healthcare.

3.1.2 Not used

3.2 Applicable Documents

MIL-STD-285	MILITARY STANDARD ATTENUATION MEASUREMENTS FOR ENCLOSURES, ELECTRO-MAGNETIC SHIELDING, FOR ELECTRONIC TEST PURPOSES, METHOD OF; 25 June 1956
IEEE Std 299-1991	IEEE STANDARD FOR MEASURING THE EFFECTIVENESS OF ELECTROMAGNETIC SHIELDING ENCLOSURES; 2 July 1991

3.3 Test Sample Set-Up

The shielded enclosure under testing will be set up in a normal configuration that consists of:

- Magnet installed including all floor mounting bolts
- RF shielded door(s)
- Waveguide penetrations, HVAC, vents, medical gas lines, etc.
- AC power supplied through low-pass filters
- Patient view window, skylights, windows, hatches, etc.
- Blank penetration panel installed, dimensionally equivalent to the GE panel and the same mounting hardware to be used with the GE penetration panel.

For safety reasons, the enclosure will be electrically grounded during the shielding effectiveness test. Any variances from the normal configuration will be noted in the certification report.

3.4 Shielding Effectiveness

This test procedure determines the worst case shielding effectiveness based on the lowest test point reading obtained. The lowest reading obtained will be the reading of the room.

3.5 Measurement Procedure

To simulate the effects of external RF sources, the transmitting antenna will be located outside the enclosure on a plane parallel to the face of the enclosure wall at a distance of 6 ft. (1.8 m) unless physically constrained to a lesser separation. The areas of least effectiveness are located by searching the inside of the enclosure with the antenna connected to the spectrum analyzer.

3.5.1 Test Position

The transmitting antenna will be positioned in front of all critical areas (doors, windows, filters, penetration areas, etc.) at a minimum of every 20 ft. (6.1 m) of the wall. The receiving antenna is scanned over all panel section joints (where accessible) at the floor, wall, and ceiling for a minimum of 10 ft. (3.05 m) in all directions from the location of transmitting antenna. The receiving antenna will be at a minimum of 1 ft. (0.3 m) from the shield. For areas that are inaccessible for direct location of the transmitting antenna, the inside of that area will still be scanned using the receiving antenna with the transmitting antenna positioned in front of the adjacent wall or test position.

3.5.2 Frequency Range

The standard frequency for shielding measurements will be 100 MHz \pm 10 MHz (150 MHz \pm 10 MHz for 3T). This allows the frequency to be adjusted slightly to avoid interference from local active transmitters and/or RF noise from other sources. Test frequency utilized will be noted in the certification report.

3.5.3 Free Field Calibration

The incident field (free field) is measured by the following procedure:

Position the transmitting antenna parallel to the exterior wall of the enclosure at a distance of 6 ft. (1.8 m) using horizontal polarization, unless physically constrained to a lesser separation, in which case a separate reference will be established and documented at the new test distance. The receiving antenna will be placed between the transmitting antenna and 1 ft. (0.3 m) from the exterior wall of the enclosure. The receiving antenna will be moved vertically and horizontally to achieve maximum signal strength. The receiving antenna will be placed no closer than 2 in. (51 mm) from the exterior wall of the enclosure and in line with the transmitting antenna. The maximum received voltage at the test frequency will be recorded.

3.6 Enclosure Power Reference Isolation



NOTICE

This section does not apply to upgrades.

To prevent personal hazard, it is necessary for the enclosure to be properly grounded.

To minimize common mode currents, the ungrounded enclosure should be isolated from the ground with a minimum of 1000 ohms of DC resistance. The isolation measurement is performed by the following procedure:

- All power to the enclosure is removed. For safety reasons, an AC voltage measurement will be made to verify that no power is connected.

- With electrical power and intentional ground disconnected, connect the test instrument between the shielded enclosure and AC power ground.
- Take a reading and record the value.

NOTE: This test must be made using either an isolated, current limited, high-voltage (>150 VDC) DC source and DMM to read drop across the limiting resistor or a Megger instrument capable of reading values less than 1000 ohms. Conventional resistance meters employing test sources of 9 VDC or less will not be used.

3.7 Test Equipment

Test equipment will be selected to provide measuring capabilities as described in these testing guidelines. The signal source, amplifier, antennas, and receiver or spectrum analyzer will be such that the difference between the induced reference voltage and the receiver sensitivity is at least 6 dB greater than the required attenuation specification.

The signal source and power amplifier will output a CW signal for a nominal test frequency of 100 mHz (150 mHz for 3T). The receiver or spectrum analyzer and preamplifier (if required) will provide adequate sensitivity to permit attenuation measurements to be made at the specified limits. Dipole antennas and other miscellaneous equipment required to transmit and receive the proper RF fields will be used.

The absolute performance calibration of the equipment requiring calibration will be performed on an as-needed basis in accordance with MIL-STD-45662. The calibration period will not exceed one year. The test equipment tolerances of at least $\pm 2\%$ frequency and ± 2 dB amplitude will be met. Equipment certifications will be traceable to the National Institute of Standards and Technology (NIST). All equipment will be verified for proper operation between and after each series of tests by repeating the reference readings at the specified frequency(s).

3.8 Data Recording and Verification

Measurements will be performed by qualified responsible EMC test personnel. The test must be performed in the presence of a GE Healthcare representative unless other arrangements were made by GE Healthcare. All data collected during the course of the tests will be recorded on standardized data sheets. The data sheets will include the test location, frequency, reference level, measured enclosure level, and attenuation level.

3.9 Test Report

A final certification report will be provided after the test is performed. This report will include all recorded data necessary for the evaluation of the shielded enclosure test results and will list any changes pertinent to the test set-up or shielding effectiveness. The certification report will also include the test procedures and a list of the actual equipment used during the test. Along with the data sheet, there will be a presentable drawing showing the shape of the enclosure, all test point locations, doors, filters, windows, and existing building walls.

4 Acoustic Design Guidelines

4.1 Magnet Room

Noise generated by the MR system is inherent to the operation of the system. The sound quality (human perception) within the Magnet Room can be modified by including sound absorbing materials to make the room sound more subdued and less harsh. The measured sound levels via a sound level meter will not change. However, the measured sound levels can be reduced only when the sound level generated by the MR System is reduced.

Sound quality improvements can be achieved by the following:

- Use ceiling tiles with fiberglass panels having a 2 inch (51mm) thickness set into the standard T-bar grid system.
- Adding fiberglass panels to the side walls covering approximately 20% of the side wall surface area. The panels should focus on covering the top half of the side walls. Panels could take many different and decorative shapes to improve the sterile look of the rooms. Typically panels might be on the order of 4ft x 6ft (1.2m x 1.8m) with a thickness of 4 inches (102mm) or equivalent. Panels shape could vary to produce mosaic effects to meet the customer preference. Any decorative materials used to cover the wall panels must be porous so that sound waves can pass through with ease. In principle, a person should be able to breath through the material with ease. Fire retardant cloth should be used. The NRC (Noise Reduction Coefficient) of the panels should be 0.95 or better when mounted against a hard surface such as drywall or concrete.

4.2 Inter-Spacial Areas

Acoustic Noise Control to mitigate noise from being transmitted to other spaces often amounts to paying attention to small details while working with ordinary construction materials. The key objectives are to eliminate all cracks and gaps in the wall construction while making sure that the doors, walls, floor, and ceiling have adequate transmission loss via mass or special double wall construction along with good fitting massive doors.

The entire Magnet must be surrounded by walls with substantial mass and/or double wall construction so that noise is contained in the room and not allowed to pass through into nearby spaces. Wall junctions must be sealed with acoustical sealant so that noise waves do not escape from the room. In principle, if the room were filled with smoke and under a positive pressure, no smoke would leak from the room.

4.2.1 Wall Construction

Wall Construction will entail ordinary building materials in a careful configuration.

- The preferred wall would have an ASTM STC 50 construction which entails the use of standard wall construction of steel studs (typically 3-5/8 inch (92 mm)) with 2 layers of Type X drywall (typically 5/8 (16 mm)) on each side totaling 4 layers and fiberglass batt in the stud cavity. All drywall must be overlapped by 6 inches (152 mm) or more. Beads of (USG) Acoustical Caulking (non-hardening) would be used around the entire perimeter of the drywall. Any form of wall penetration should be avoided. Any necessary wall penetrations must be sealed using combination of Acoustical Caulking (non-hardening) and fiberglass batt material. See examples of wall construction shown in [Illustration 12-5](#) and [Illustration 12-6](#).

- The top of the wall must join the ceiling/floor above so that no cracks or gaps occur. If metal pan is used on the ceiling/floor (above), then flute seals would be used to seal the gaps between the drywall and the pan. Alternately drywall can be cut out to fit into the flutes. Acoustical caulking (non-hardening) will be used to seal the remaining cracks and gaps.

Illustration 12-5: Example Of Wall Construction For Airborne Noise Control - Option 1

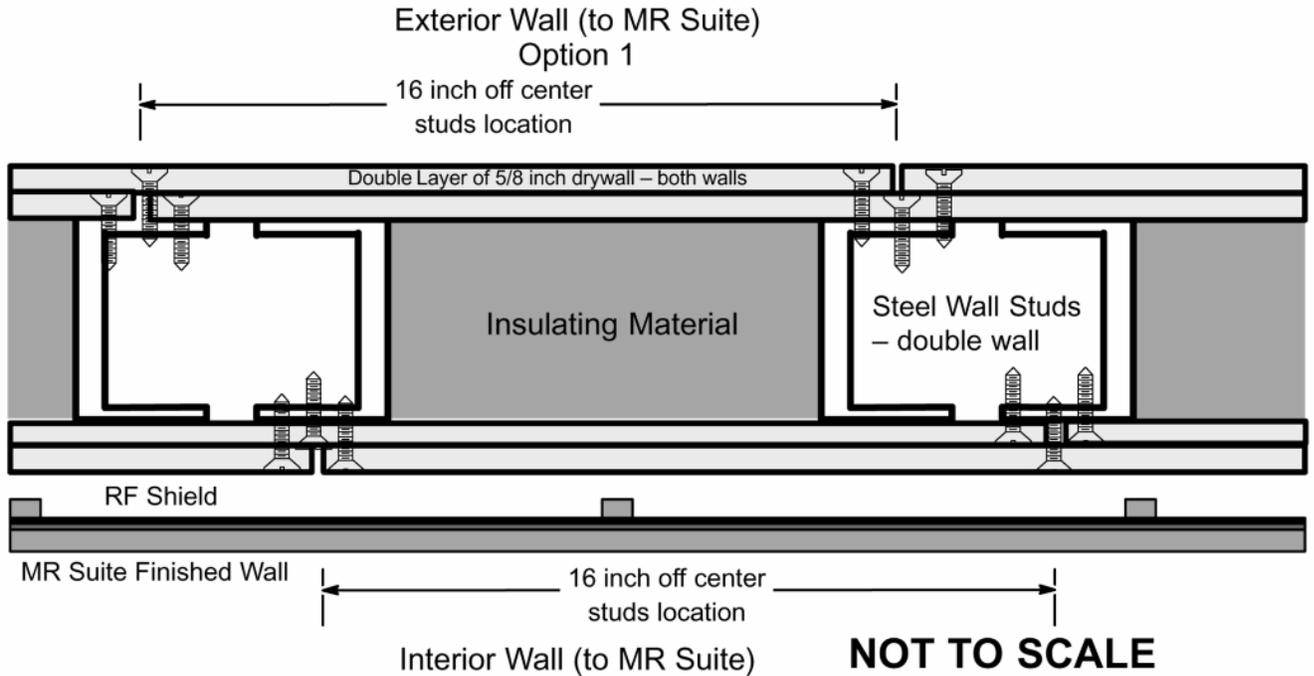
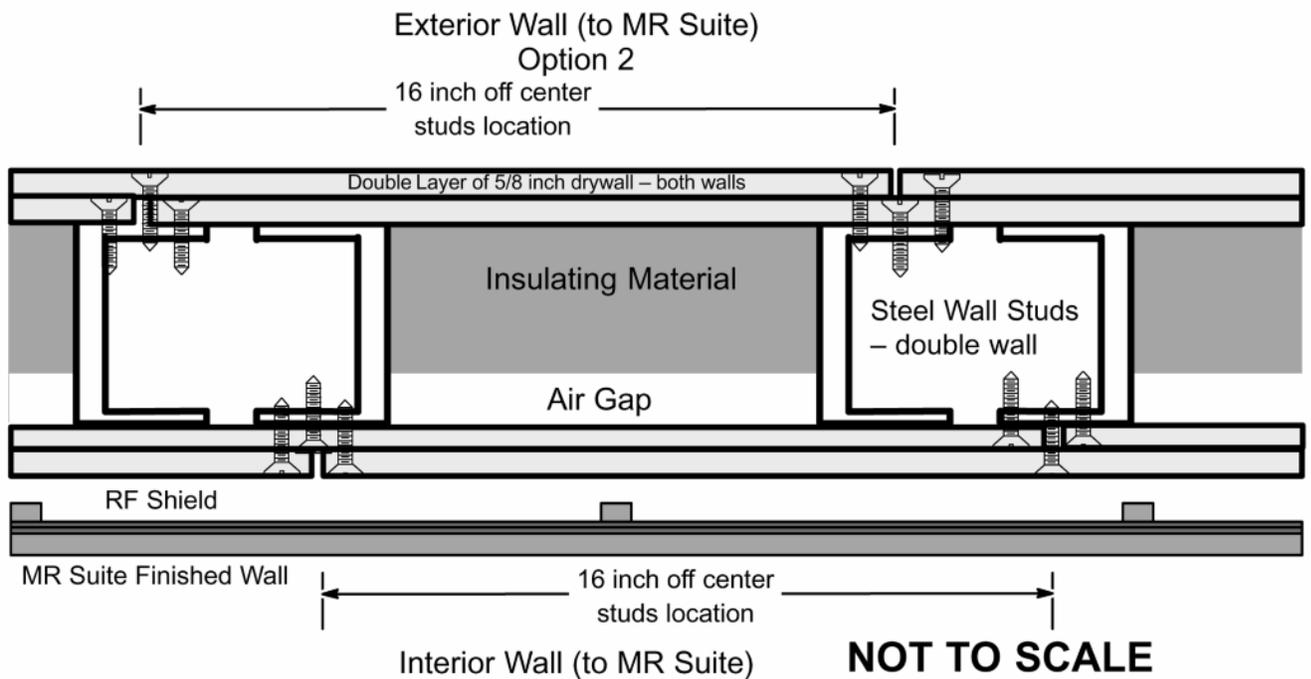


Illustration 12-6: Example Of Wall Construction For Airborne Noise Control - Option 2



4.2.2 High Bay RF Room

A high bay RF Room is a self contained RF Room which has open air space between the RF Room ceiling and the building floor above. The air space is an acoustic transmission path. Acoustic energy must be reduced to minimize this transmission of energy through this path.

In cases where the Magnet is to be installed in a high bay, it may be most effective to enclose the RF Room with its own drywall and steel stud room. The key difference being a ceiling assembly that mimics the sidewall construction to contain noise.

- Normal high STC stud walls from above would be used to support a ceiling assembly constructed of structural C channel with two layers of drywall on each side (total of 4 layers) with fiberglass batt in the cavity.
- Penetrations should be avoided via the use of surface mounted lights. HVAC and ducts passing through the ceiling, party wall or side walls would require acoustic noise attenuation in the form of inline silencers. Gaps and cracks would be sealed between the ceiling, party wall or vertical side walls and the cryogen vent plumbing. In essence the Magnet would be enclosed in a drywall "doghouse".

4.2.3 Miscellaneous Plumbing, RF Windows and RF Doors

Other construction details are equally important to mitigate noise transmission to meet the intended goal.

- Pipes (gas or water) and electrical conduit or Magnet Room signal cables must be sealed where they penetrate the walls or ceiling. A heavy mastic material such as Duxseal™ is appropriate.
- RF windows should be purchased as window/frame units with an STC rating obtained from laboratory testing per ASTM standards. STC 50 to 60 windows are needed. The installation must include proper sealing to avoid sound leaks.
- RF doors should be selected to provide an STC 50 to 60 to quell the noise. Contact RF Shield Room supplier for selection of RF doors that meet the local acoustic codes and site acoustic requirements. RF door seals must be selected to prevent small gaps around the door perimeter and at the door threshold. RF door seals would either require periodic replacement or a door seal that would last the life of the Magnet Room.

© 2010 General Electric Company.

GE Medical Systems, a General Electric Company, going to market as GE Healthcare.

www.gehealthcare.com

